

U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-297 454

Removal of Lagoon Effluent Suspended Solids by a Slow-Rock Filter

Kansas Univ, Lawrence Dept of Civil Engineering

Prepared for

Municipal Environmental Research Lab, Cincinnati, OH

Jun 79

TECHNICAL REPORT DATA (Please read Instructions on the reverse before completing)		
1. REPORT NO. EPA-600/2-79-011	2.	3. RECIPIENT'S ACCESSION NO. PB297454
4. TITLE AND SUBTITLE REMOVAL OF LAGOON EFFLUENT SUSPENDED SOLIDS BY A SLOW-ROCK FILTER	5. REPORT DATE June 1979 (Issuing Date)	
	6. PERFORMING ORGANIZATION CODE	
7. AUTHOR(S) Walter J. O'Brien and Ross E. McKinney	8. PERFORMING ORGANIZATION REPORT NO.	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Environmental Health Research Laboratory University of Kansas Lawrence, Kansas 66045	10. PROGRAM ELEMENT NO. 1BC611, SOS #3, Task D 1/18	
	11. CONTRACT/GRANT NO. 68-03-0280	
12. SPONSORING AGENCY NAME AND ADDRESS Municipal Environmental Research Laboratory --Cin., OH Office of Research and Development U.S. Environmental Protection Agency Cincinnati, Ohio 45268	13. TYPE OF REPORT AND PERIOD COVERED Final, 1973-1975	
	14. SPONSORING AGENCY CODE EPA/600/14	
15. SUPPLEMENTARY NOTES Project Officer: Ronald F. Lewis, (513) 684-7644		
16. ABSTRACT The objective of this project was to examine the removal of algae cells and other suspended solids contained in the effluents from facultative lagoons treating domestic wastewaters by means of rock filters. Two rock filters were constructed and operational over a 16 month period to determine the operating characteristics of the rock filter systems. Both rock filters removed essentially the same amount of suspended solids but the small rock filter clogged after 11 months operation. Biological activity within the rock filter was noted by the changes in dissolved oxygen concentrations. The data indicated that it was not possible to obtain effluent suspended solids concentrations below the desired 30 mg/l for municipal wastewater treatment systems. The BOD ₅ concentrations in the effluents from the rock filters were consistently below the 30 mg/l effluent criteria.		
17. KEY WORDS AND DOCUMENT ANALYSIS		
a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
*Filtration Effluents *Lagoons (ponds) *Algae	*Wastewater lagoons (ponds) *Algae separation Rock filter	13B
18. DISTRIBUTION STATEMENT Release to public.	19. SECURITY CLASS (This Report) unclassified	21. NO. OF PAGES 120
	20. SECURITY CLASS (This page) unclassified	22. PRICE PCF66/MT-P01

United States
Environmental Protection
Agency

Municipal Environmental Research
Laboratory
Cincinnati OH 45268

EPA-600/2-79-011
June 1979

Research and Development

PB 297454



Removal of Lagoon Effluent Suspended Solids by a Slow-Rock Filter

JUL 03 1979

REPRODUCED BY
**NATIONAL TECHNICAL
INFORMATION SERVICE**
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

RESEARCH REPORTING SERIES

Research reports of the Office of Research and Development, U.S. Environmental Protection Agency, have been grouped into nine series. These nine broad categories were established to facilitate further development and application of environmental technology. Elimination of traditional grouping was consciously planned to foster technology transfer and a maximum interface in related fields. The nine series are:

1. Environmental Health Effects Research
2. Environmental Protection Technology
3. Ecological Research
4. Environmental Monitoring
5. Socioeconomic Environmental Studies
6. Scientific and Technical Assessment Reports (STAR)
7. Interagency Energy-Environment Research and Development
8. "Special" Reports
9. Miscellaneous Reports

This report has been assigned to the ENVIRONMENTAL PROTECTION TECHNOLOGY series. This series describes research performed to develop and demonstrate instrumentation, equipment, and methodology to repair or prevent environmental degradation from point and non-point sources of pollution. This work provides the new or improved technology required for the control and treatment of pollution sources to meet environmental quality standards.

EPA-600/2-79-011

June 1979

REMOVAL OF LAGOON EFFLUENT SUSPENDED
SOLIDS BY A SLOW-ROCK FILTER

by

Walter J. O'Brien
and
Ross E. McKinney
Department of Civil Engineering
University of Kansas
Lawrence, Kansas 66045

Contract No. 68-03-0280

Project Officer

Ronald F. Lewis
Wastewater Research Division
Municipal Environmental Research Laboratory
Cincinnati, Ohio 45268

MUNICIPAL ENVIRONMENTAL RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OHIO 45268

ja

DISCLAIMER

This report has been reviewed by the Municipal Environmental Research Laboratory, U.S. Environmental Protection Agency, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the U.S. Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

FOREWORD

The Environmental Protection Agency was created because of increasing public and government concern about the dangers of pollution to the health and welfare of the American people. The complexity of the environment and the interplay between its components require a concentrated and integrated attack on the problem.

Research and development is that necessary first step in problem solution and it involves defining the problem, measuring its impact, and searching for solutions. The Municipal Environmental Research Laboratory develops new and improved technology and systems for the prevention, treatment, and management of wastewater and solid and hazardous waste pollutant discharges from municipal and community sources, for the preservation and treatment of public drinking water supplies, and to minimize the adverse economic, social, health, and aesthetic effects of pollution. This publication is one of the products of that research; a most vital communications link between the researcher and the user community.

As part of these activities, this research report was prepared to make available to the sanitary engineering community data on the design and operating characteristics of rock filters for removing suspended solids from the effluent of a municipal wastewater lagoon.

Francis T. Mayo, Director
Municipal Environmental Research
Laboratory

ABSTRACT

Data on the effectiveness of a field scale pilot plant employing rock filters for the removal of suspended solids from the effluent of the facultative wastewater lagoon system at Eudora, Kansas, were examined for a 16 month period. Two rock filters were evaluated, one using Corp of Engineer ballast rock, 4.7 to 25.4 mm, and the other using standard filter rock, 9.5 to 50.8 mm.

The three cell, facultative lagoon treating Eudora municipal wastewaters was operated at 55 per cent of its hydraulic design capacity and had an average fluid retention time of 246 days. The effluent from Cell 3 showed an average of 60 mg/l suspended solids, 21 mg/l suspended BOD₅, 3.8 mg/l soluble BOD, 3.0 mg/l $\text{NH}_4^+\text{-N}$, 3.3 mg/l total P, 10.7 mg/l dissolved oxygen and a pH of 8.5. These data indicated good stabilization of the municipal wastewater contaminants with algal recycling of nutrients. The high effluent suspended solids were created primarily by algae recycling treated nutrients. While the effluent contained considerable suspended solids, the reduction of N and P was significant.

Both rock filters dropped the suspended solids to an average of 32 to 35 mg/l. Variations in hydraulic loading rates up to 2978 l/m³/day did not have any effect on the effluent suspended solids concentrations, but the small rock filter clogged after 11 months operation, indicating the need for larger rock media.

The removal of suspended solids within the rock filters resulted in a definite dissolved oxygen drop through the filters from biological metabolism. In the warm summer period there was not enough dissolved oxygen in the rock filter influent to meet the oxygen demand and anaerobic conditions were produced in the rock filters. In the cold winter period the increased dissolved oxygen was adequate to keep the system aerobic. Biological activity remained high during the winter months.

The results of this study indicated that rock filters could not produce an effluent quality that would meet the EPA effluent criteria of 30 mg/l suspended solids even though there was a definite reduction in suspended solids.

This report was submitted in fulfillment of Contract No. 68-03-0280 by the University of Kansas under the sponsorship of the U.S. Environmental Protection Agency. This report covers a period from June 19, 1973 to October 31, 1975, and work was completed as of October 1978.

CONTENTS

Foreword	iii
Abstract	iv
Figures	vi
Tables	vii
Acknowledgment	viii
1. Introduction	1
2. Conclusions	6
3. Recommendations	7
4. Experimental Facilities	8
5. Experimental Program	15
Eudora Lagoon Effluent	16
Rock Filter Influent	19
Large Rock Filter	20
Small Rock Filter	29
Chlorophyll and Algae	33
6. Discussion of Results	39
References	42
Appendices	43

FIGURES

<u>Number</u>	<u>Page</u>
1 Schematic diagram of facultative lagoon operation	2
2 Schematic diagram of wind mixing in facultative lagoons	2
3 Schematic diagram of the Eudora lagoon system and the experimental filter	9
4 Schematic diagram of the pilot rock filter lagoon	9
5 Media used in the large rock filter	11
6 Media used in the small rock filter	11
7 Centerwall and rock filters during construction	13
8 Rock filters looking from effluent end towards the influent end during construction	13
9 A cross section of the rock filters	14
10 Influent and effluent suspended solids from the large rock filter system	23
11 Total BOD ₅ data for the large rock filter system	25
12 Soluble COD data for the large rock filter system	26
13 Dissolved oxygen data for the large rock filter system	27
14 Ammonium nitrogen data for the large rock filter system	28
15 Suspended solids small rock filter	30
16 Total BOD ₅ small rock filter	31
17 Ammonium nitrogen data for the small rock filter system	32
18 Suspended solids removed in rock filters	40
19 BOD removed in rock filters	40

TABLES

<u>Number</u>	<u>Page</u>
1 Size Gradation of the Rock Used in the Two Field Scale Filters . .	10
2 Monthly Averages of Cell 3 Effluent	17
3 Monthly Averages From Cell 3	18
4 Monthly Average Chemical Characteristics	20
5 Hydraulic Loadings and Detention Times in Each Filter System . . .	21
6 Dissolved Oxygen Concentrations Across Large Rock Filter	24
7 Dissolved Oxygen Concentrations Across Small Rock Filter	33
8 Chlorophyll A Through Rock Filter System	34
9 Predominant Algae in Cell 3 Effluent	35
10 Predominant Algae in Rock Filter Influent.	35
11 Predominant Algae in Large Rock Filter Effluent.	36
12 Predominant Algae in Small Rock Filter Effluent.	36
13 Total Alkalinity Through Rock Filter Lagoon System	37

ACKNOWLEDGMENTS

The cooperation of the City of Eudora, and most especially Mr. John W. Pinnick, Superintendent of Utilities, is gratefully acknowledged.

The number of graduate and undergraduate students who worked on the project is too large to make individual recognition feasible. Despite this, they have our heartfelt thanks for their tireless performance.

The assistance of Mrs. Kathleen Boyd throughout the entire project is also gratefully acknowledged. The assistance of Ms. Molly Van Vleck in the final preparation of this report is gratefully acknowledged.

SECTION 1

INTRODUCTION

Facultative lagoons have been widely used for the treatment of wastewaters from small communities, subdivisions, shopping centers and isolated industrial plants as well as for individual residences. The popularity of lagoons has been based upon relatively low first costs, low operational and maintenance costs and high standards of reliability in stabilizing the biodegradable organics in raw wastewaters. For the most part, lagoons have been used where large land areas were readily available and where skilled operating personnel were not readily available. In addition to facultative lagoons, aerated lagoons and anaerobic lagoons have also been used for wastewater treatment. Needless to say, all three types of wastewater lagoons have their own specific characteristics.

Facultative lagoons are the most widespread of the three types of lagoons and can be characterized as being large, shallow, holding ponds that retain the wastewaters for 90 to 120 or more days. Facultative lagoons work best on relatively dilute organic wastewaters and produce a high degree of treatment as far as stabilization of the biodegradable organics are concerned. Aerated lagoons utilize some form of mechanical surface aeration or diffused aeration to increase the rate of oxygen transfer and reduce the aeration time down to between 1 and 20 days. Aerated lagoons do an excellent job of stabilizing the biodegradable organics but tend to produce considerable quantities of suspended solids that must settle in the aerated lagoon or in a separate treatment system. Anaerobic lagoons tend to be deep lagoons, 3 to 6 meters (10 to 20 ft), with a relatively short retention period, 3 to 6 days. Anaerobic lagoons work best on strong industrial wastes that contain high proteins and produce up to 80 per cent BOD₅ reduction. It is normal to follow anaerobic lagoons with either aerated lagoons or facultative lagoons or a combination of both to produce a high quality effluent.

THEORY OF FACULTATIVE LAGOONS

Removal of contaminants from wastewaters depends upon both physical and biological phenomena. Figure 1 is a schematic diagram of a typical facultative lagoon. As shown in Figure 1, the heavy suspended solids in the incoming wastewaters tend to settle out near the wastewater inlet since the velocity of flow in the lagoon is not sufficient to keep them in suspension. The suspended solids in normal municipal wastewaters consist of inorganics and organics with the organic fraction having both a biodegradable fraction and a non-biodegradable fraction. The inorganic and the non-biodegradable volatile suspended solids that settle out in the lagoon simply accumulate on the bottom. The large surface area of facultative lagoons permits the inert suspended solids to accumulate for many years before filling the lagoon.

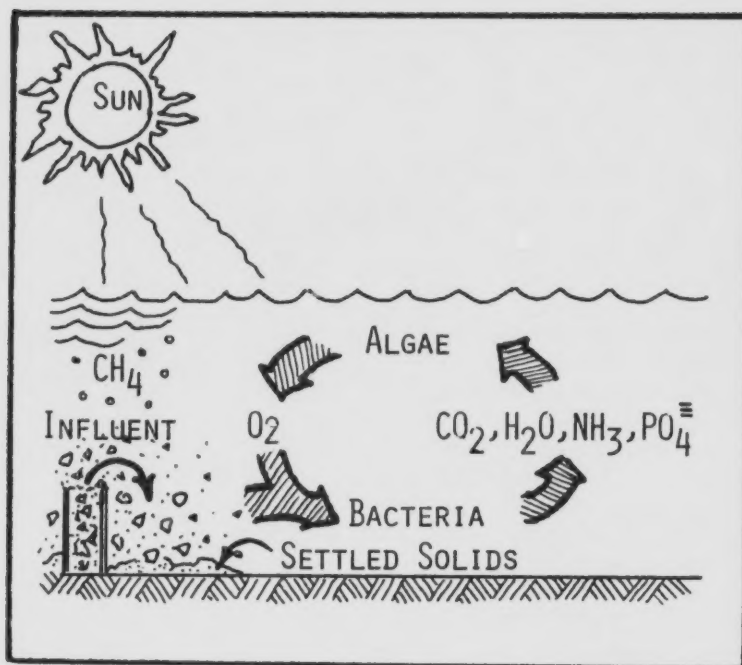


FIGURE 1. SCHEMATIC DIAGRAM OF FACULTATIVE LAGOON OPERATION.

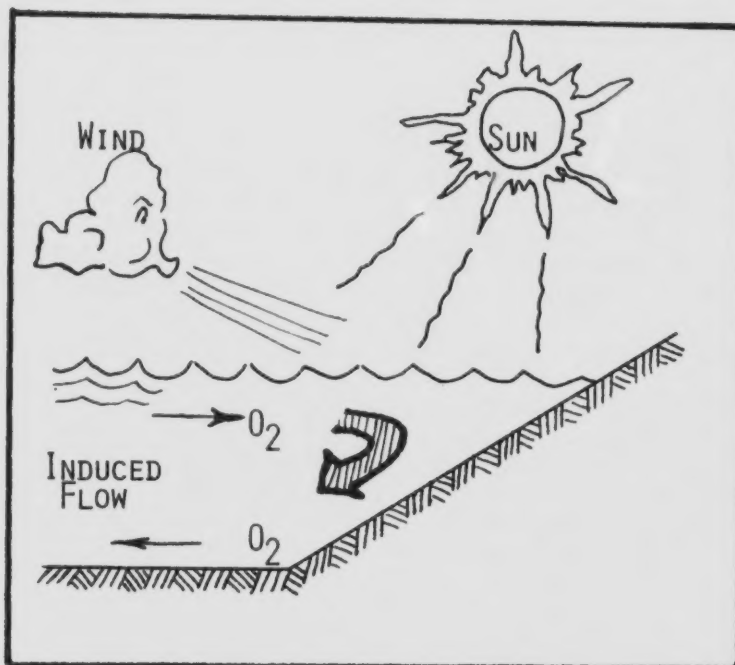


FIGURE 2. SCHEMATIC DIAGRAM OF WIND MIXING IN FACULTATIVE LAGOONS.

The biodegradable fraction of the settled suspended solids undergoes anaerobic degradation by various groups of bacteria. Facultative, acid-forming bacteria metabolise the readily degradable suspended solids with the formation of soluble organics, primarily short chain volatile acids, which slowly diffuse into the liquid surrounding the solids. If acid formation is rapid, the pH of the liquid immediately around the suspended solids can drop to a point where further metabolism ceases. In effect, the organic suspended solids which settled out are pickled by the organic acids. Wind action across the surface of the facultative lagoon causes the water to circulate around the lagoon, as shown in Figure 2. As the water moves across the surface of the settled suspended solids, some of the soluble organics diffuse into the moving layer. With time the methane bacteria slowly start to grow in the anaerobic environment within the settled sludge layer. They convert the organic acids to methane and carbon dioxide which tend to form gas bubbles which are released from the lagoon into the atmosphere. Part of the carbon dioxide produced by metabolism reacts with ammonia released during the metabolism of proteins to form ammonium bicarbonate which acts as a buffer to maintain proper pH levels, around pH 7, for good bacterial metabolism. The loss of gas from the lagoon and the formation of ammonium bicarbonate are important reactions affecting the operation of the facultative lagoon.

The soluble, biodegradable organics in the incoming wastewaters, as well as the soluble organics released from the settled suspended solids, are metabolised by facultative bacteria to form new bacterial cells. The overall reaction is one of conversion of soluble organic matter to suspended organics in the form of cellular protoplasm. If dissolved oxygen is available to the bacteria, the metabolic reactions will be aerobic with approximately 2/3 of the biodegradable organics being converted to bacterial mass in the form of volatile suspended solids and 1/3 of the organics being oxidized for energy to produce the new cells. Aside from new protoplasm, the major end products of the metabolic reactions are carbon dioxide and water with some ammonium ions being released from protein degradation. The ammonium ions react with water and carbon dioxide to form ammonium bicarbonate.

The bacterial protoplasm formed is not a stable material but rather undergoes endogenous respiration, using oxygen and producing carbon dioxide, water, ammonia and an inert, cell residue as end products. Thus, the bacteria grow up and die with the contaminants in the wastewaters being removed rather quickly to form new cells and the stable end products being slowly released as the cells age. In addition to the facultative bacteria which metabolise the organics in the wastewater, there is also a group of bacteria which can oxidize the ammonium ions to nitrate ions. The nitrifying bacteria are strict aerobics and use carbon dioxide rather than organic matter as their source of carbon for their protoplasm.

When adequate oxygen is not available for aerobic metabolism, the facultative bacteria simply shift to anaerobic metabolism. Unfortunately, the end products of anaerobic metabolism are primarily organic acids, aldehydes, ketones and alcohols. These organic end products still contain much of the energy from the original organics being metabolised. The net result is less bacterial cell mass being produced and less overall stabilization.

Sulfate reducing bacteria find the anaerobic conditions suitable for growth and obtain the energy they need by oxidizing the organic matter with sulfates as their electron acceptor. Sulfates are reduced to sulfides which can build up to produce nuisance odors. If the wastewaters contain iron, the iron will react with the sulfides to produce a black, insoluble precipitate. The precipitation of the sulfides helps reduce the odor potential but also reduces the light penetration into the lagoon until the precipitate settles out. Overall, anaerobic metabolism does not produce a high quality effluent and only the reaction of methane bacteria in the settled sludge layer produces reasonable removal of organic matter under anaerobic conditions.

Although bacteria stabilize the organics contained in wastewaters, other microorganisms also grow in facultative lagoons. The most important group of microorganisms outside of bacteria are algae which utilize inorganic nutrients and sunlight to provide the necessary reactants for creating new algae cells. Sunlight provides the energy needed to convert the inorganic elements into organic matter as algae protoplasm. Thus, soluble inorganic compounds are converted to insoluble organic suspended solids. Algae produce cellular protoplasm similar to bacterial protoplasm as far as overall chemical composition is concerned. Like bacteria algae also undergo endogenous respiration with the use of oxygen to produce carbon dioxide, water, ammonium ions and inert cell mass. In the presence of light the endogenous end products are quickly converted back to new cell mass with little loss. Synthesis of new protoplasm makes it appear that the algae are not undergoing endogenous respiration when they actually are. The turnover of nutrients results in the slow accumulation of inert, dead algae mass which has no definite form except for the algae which have hard shells. At night the algae do not have light energy for synthesis, making endogenous respiration the primary reaction with continuous release of end products to the water around the algae. Some of the carbon dioxide may be lost from the lagoon surface at night but much of it is retained as bicarbonates. When daylight returns, the algae begin to metabolize the inorganic nutrients released by endogenous respiration at night. The net effect is reuse of most of the nutrients on a continuous basis.

Algae would create a serious problem if it were not for the fact that oxygen is a major end product of metabolism. As carbon dioxide and water are converted to cellular protoplasm. Most of the oxygen is released as molecular oxygen which diffuses out into the lagoon where it can be used by the bacteria for aerobic metabolism of the organics. Unfortunately, some of the oxygen released can be lost from the lagoon surface as a result of wind action. Supersaturation of the surface layer of the lagoon with oxygen is quite common with heavy algae growths. Removal of carbon dioxide and water by algae results in an increase in hydroxyl ions which react with the remaining bicarbonate ions to produce carbonates and raise the pH. The pH in lagoons with active algae metabolism can easily rise to 9.5 or higher. The high pH levels produced by algae metabolism tends to slow overall microbial reactions but does not stop metabolism.

Higher microorganisms such as protozoa, rotifers and crustaceans find the aerobic environment in the lagoons suitable for growth. These animals

are able to use the bacteria and the algae as food and grow in direct proportion to their ability to obtain nutrients. Bacteria utilization tends to keep the bacteria population to a minimum but algae utilization is much more selective. The small, non-motile algae form an excellent source of nutrients for the microscopic animals; but the larger algae, the motile algae and the spinelike algae are not readily metabolised by the microscopic animals. Un-metabolised algae, dead algae, living and dead bacteria, protozoa, crustaceans and wastewater colloidal solids form the mass of suspended solids that persists beyond the immediate vicinity of the inlet to the lagoon. Since these tiny suspended solids settle slowly and are easily kept in suspension by wind action across the surface of the lagoon, it is not surprising that the lagoon effluent contains a high concentration of suspended solids.

The EPA criteria for secondary effluents from municipal wastewater treatment plants specifies that suspended solids and BOD₅ shall not exceed 30 mg/l on a 30 day average with 45 mg/l on a 7 day average. Unfortunately, the growth of algae results in high suspended solids during the warm summer months which exceeds the EPA effluent criteria. As a net result, considerable research has been carried out over the past 15 years to determine the best method for removing suspended solids from lagoon effluents. One of the most comprehensive reviews of various methods that have been studied was prepared by Middlebrooks et al.¹ They listed 14 different methods for removing lagoon suspended solids but indicated that none of them had proven economically feasible by 1974 when their review was published.

Another method which had not been previously examined but which had potential was the large rock media filter. A laboratory pilot plant employing a rock media filter was studied initially by D.M. Martin² at the University of Kansas in 1970. Results were sufficiently promising to stimulate a field scale pilot study on a small scale by J.L. Martin and R. Weller³. Results from these two studies were combined into a large scale pilot plant study that was proposed and accepted by EPA. This report deals with the construction and operation of the field scale rock filter pilot plant at Eudora, Kansas, by the Environmental Health Research Laboratory of the University of Kansas and represents the most detailed study to date on the use of a large rock filter system to remove the suspended solids from the effluent of an operational facultative lagoon system treating municipal wastewaters from a typical, small, midwestern community.

SECTION II

CONCLUSIONS

The following conclusions were drawn from the data obtained in this study.

1. The 3 cell facultative lagoon treating Eudora municipal wastewaters operated at 55 percent hydraulic capacity and produced an effluent containing an average of 60 mg/l suspended solids and 21 mg/l BOD₅.
2. The rock filter pilot plant gave limited suspended solids reductions, dropping the influent from an average of 53 mg/l to between 32 and 35 mg/l.
3. The suspended solids concentrations in the effluent from the rock filters were unaffected by hydraulic flow through the rock filters up to the maximum loading rate of 2978 l/m³/day in the large rock filter and 2188 l/m³/day in the small rock filter.
4. The removal of suspended solids by the rock filters was directly proportional to the suspended solids applied with both the small rock filter and the large rock filter removing the same quantities of suspended solids.
5. The biological degradation within the rock filter resulted in decreased dissolved oxygen concentrations.
6. The results of the rock filter pilot plant were not sufficient to justify recommending the use of rock filters as a method for reducing the effluent suspended solids from a facultative lagoon to meet the 30 mg/l EPA effluent criteria.

SECTION III

RECOMMENDATIONS

This pilot plant study showed that the rock filter could help reduce the suspended solids in wastewater lagoon effluents but the reduction was not sufficient to produce a consistent effluent quality under 30 mg/l suspended solids. The reduction in suspended solids was related to the nature of the suspended solids. Algae made up the major fraction of suspended solids applied to and removed by the rock filter. For the most part the predominant algae in this study were Oscillatoria, Chlorella, Scenedesmus and Nitzschia. These algae were relatively small and difficult to remove.

During the course of this research project a number of engineers requested information on the potential of the rock filter. Several rock filters have been designed based on the preliminary data which showed reasonable results. Because of the limited size of this pilot plant, it will be necessary to examine several full scale systems to determine the real characteristics of the rock filter under daily operating conditions for several years.

Since the EPA Construction Grant Program is responsible for funding most improvements and additions to municipal wastewater treatment systems, EPA should maintain a list of all plants where rock filters have been approved as part of the treatment system. As data on plant operations becomes available on a regular basis, efforts should be made to correlate the data with anticipated results and to publish the information so that consulting engineers can be made aware of the value or the lack of value of rock filters.

As problems are reported in the field, EPA should note the problems and determine the seriousness of these problems. Where possible, solutions should be developed to improve operations either by the EPA or other researchers interested in this area.

If possible, EPA should select one or two typical rock filter installations and examine them in detail over a period of at least one year to determine in greater depth what results might be expected in contrast to the limited data than would be available through the normal data reporting mechanisms.

SECTION IV

EXPERIMENTAL FACILITIES

The municipal wastewater lagoon system at Eudora, Kansas was selected for testing the rock filter concept. The lagoon system consisted of three cells in series and was designed to treat the wastewaters from a population of 4,000 people. The design flow was based on a projected flow of 379 l/capita/day (100 gcpd) dry weather flow. The average depth of water in each cell was 1.5m (5 ft). Black and Veatch, the design engineers, followed the design criteria recommended by the Division of the Environment, Kansas State Department of Health.⁴ Efforts were made to provide maximum operational flexibility by providing piping to permit different operating patterns.

The primary operational pattern is shown in Figure 3. Raw wastewaters are pumped from Eudora to the lagoon which is located just outside of the residential area on the west side of Eudora next to the Wakarusa River. A diversion box located between the three cells permitted splitting the flow to the first two cells or directing the flow to either cells 1 or 2. During the time over which this study was made, the wastewater flow was diverted into Cell 1 which had an area of 3.16 ha (7.8 acres). The effluent from Cell 1 was discharged to Cell 2 which had an area of 1.50 ha (3.7 acres). From Cell 2 the flow went to Cell 3 which had an area of 3.17 ha (7.8 acres). The total area of the lagoon system was 7.83 ha (19.3 acres). The estimated water volume in each cell was as follows: Cell 1, 45.7×10^6 l, Cell 2, 21.3×10^6 l and Cell 3, 45.9×10^6 l.

The Eudora lagoon system was placed into operation in 1972 and had a sewered population of approximately 2,200 people when data collection was started in 1974. The average daily dry weather flow in 1973 was approximately 208 l/capita/day (55 gcpd). This flow yielded theoretical retention times of 100 days each in Cells 1 and 3 and 46 days in Cell 2 for a total retention time of 246 days. This facultative lagoon system was typical for municipal wastewater treatment in the midwestern part of the United States in that it operated well below design capacity. In spite of the low organic load and the long retention time, the effluent quality from Cell 3 generally exceeded EPA effluent suspended solids criteria, making it an excellent system for testing the rock filter concept.

The experimental rock filter was designed to examine two different rock sizes as well as the overall concept of rock filtration. The pilot plant used to evaluate the rock filter was constructed adjacent to the existing lagoon system as shown in Figure 3. The test lagoon was constructed as a small section of a normal lagoon. The size of the test lagoon was limited to a reasonable size for proper evaluation and to a size which could be easily

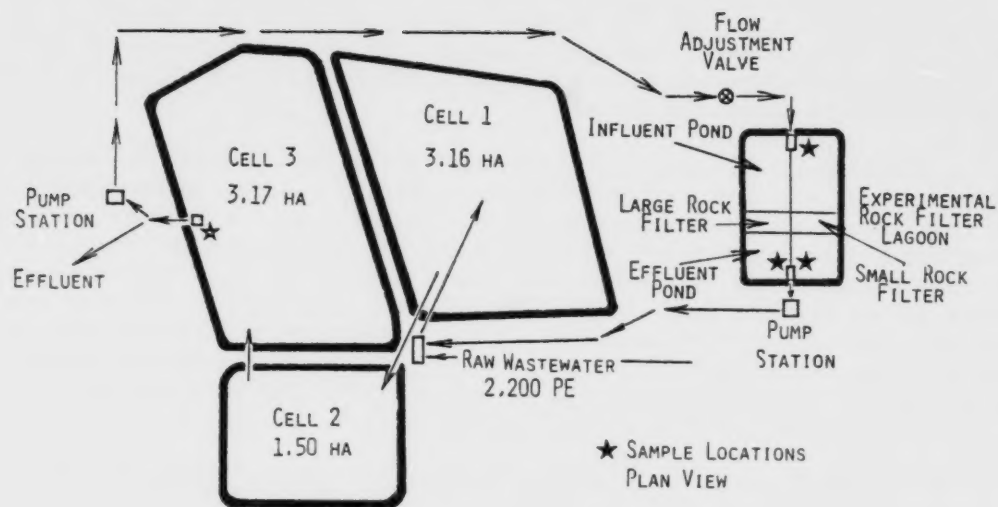
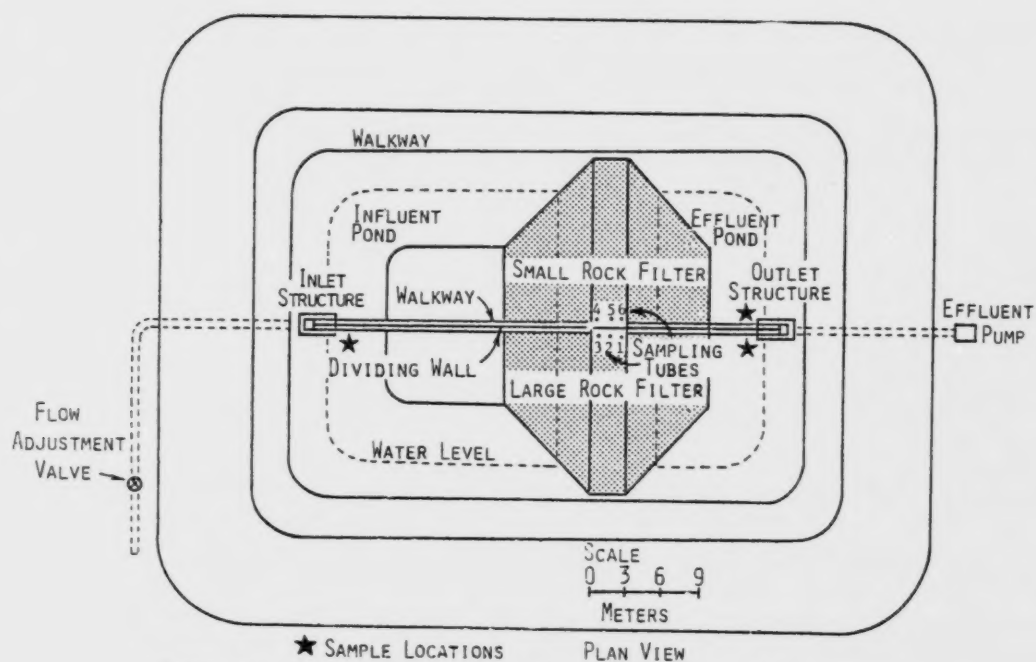


FIGURE 3. SCHEMATIC DIAGRAM OF THE EUDORA LAGOON SYSTEM AND THE EXPERIMENTAL FILTER.



★ SAMPLE LOCATIONS PLAN VIEW
FIGURE 4. SCHEMATIC DIAGRAM OF THE PILOT ROCK FILTER LAGOON.

filled in when the study was completed. The lagoon was designed so that the volume of earth removed during its construction equaled the volume of earth for dikes above the natural ground surface. The length of the test lagoon was approximately 41m (135 ft) between the top edges of the dikes around the test lagoon and the width was approximately 28m (92 ft). The water level within the test lagoon was maintained at 1.22m (4.0 ft) with the dikes having a height of 1.5m above the bottom.

A center wall of asphalt coated sheet piling was constructed along the middle axis of the test lagoon as shown in Figure 4. The center wall divided the test lagoon into two separate cells of equal size. A walkway was placed along the top of the divider wall to permit easy access across the center of the test lagoon. The rock media was placed across the test lagoon approximately 2/3 of the distance between the influent end and the effluent end. Both rock filters were constructed 1.4m (4.5 ft) high so that influent would flow over the top of the rock filter if the filter should become clogged rather than flowing over the dikes around the test lagoon. The rock slopes were approximately 3:1 on a horizontal to vertical basis.

Two sizes of rock were used in the rock filters to determine the relative merits of large rock media with large void spaces and small rock media with small void spaces. Approximately 400 tons of each type of rock was used in the construction of the rock filters. The rock types were chosen for their availability and lower cost. Special rock sizes take special orders and require both more time to obtain and more expense. The rock filters were composed of crushed limestone having the size gradations shown in Table 1.

TABLE 1. SIZE GRADATION OF THE ROCK USED IN THE TWO FIELD SCALE FILTERS

Sieve Opening mm	% Weight Retained	
	Large Rock	Small Rock
50.8	7.4	
38.1	28.8	
25.4	52.0	13.4
19.1	10.4	33.1
12.7	1.3	39.0
9.5	0.1	10.4
6.7		3.2
4.7		0.9
Porosity	0.44	0.44

The large rock media was standard filter rock while the small rock media was Corp of Engineer ballast rock. Photographs of the two rock media are shown in Figures 5 and 6. Both photographs were taken from the same distance to show the relative sizes of the two rock media. The large rock filter had a



Figure 5. Media used in the large rock filter.



Figure 6. Media used in the small rock filter.

base width of 13.7m (45 ft) and a top width of 5.5m (18 ft). The small rock media compacted more than the large rock media and had a base width of 14.3m (47 ft) and a top width of 6.1m (20 ft). Figures 7 and 8 show how each rock filter looked before the start of the study. Figure 7 shows the center wall and the rock filters before the walkway was constructed. Figure 8 shows the outlet structure and the two rock filters across the test lagoon.

In an effort to obtain data inside of the rock filter, three sampling tubes were placed vertically across each filter at 2.7m (9 ft) on center as shown in Figure 3. The sampling tubes were 102mm (4 inches) diameter plastic pipe with a series of holes, 12.7mm (0.5 inch) diameter, spaced at 76.2mm (3 inches) intervals. Each series of holes consisted of four holes at 90° spacing. The cross-section of the rock filter and sampling tubes is shown in Figure 9.

Part of the effluent from Cell 3 of the Eudora lagoon system was collected by gravity in a well and was pumped by a 2 HP submersible pump through a 102mm (4 inches) diameter plastic pipe to the inlet of the test lagoon. A 152mm (6 inches) cast iron pipe was placed through the lagoon dikes to prevent crushing the influent pipe. The inlet structure split the influent flow between the two rock filters. Two 15° V-rated weirs were used to measure the flow to each side of the test lagoon. The outlet structure was designed to collect the effluent from the rock filters. Wooden stop planks were used to control the water level in the test lagoon and a second set of 15° V-notch weirs were used to measure the flows out of the test lagoon. Baffles were placed around the out structure to a depth of 0.76m (2.5 ft) below the water surface to prevent scum from the surface being discharged in the effluent. The effluent was collected in a second wet well and was pumped back to the inlet structure of the Eudora lagoon system.

The design of the rock filters in the test lagoon resulted in two influent ponds ahead of the rock filters and two effluent ponds. The influent ponds contained approximately 120m³ at the normal operating depth of 1.22m. The effluent pond volume was 85m³.

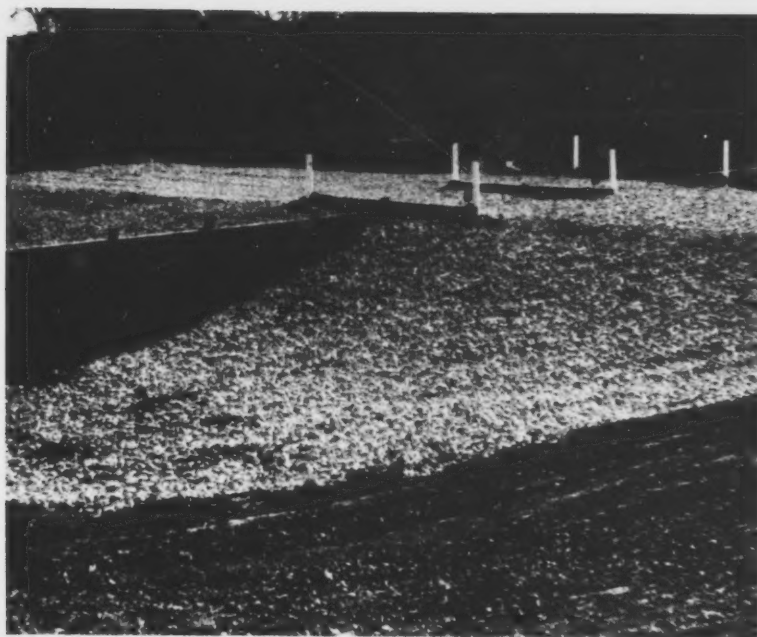


Figure 7. Centerwall and rock filters during construction.

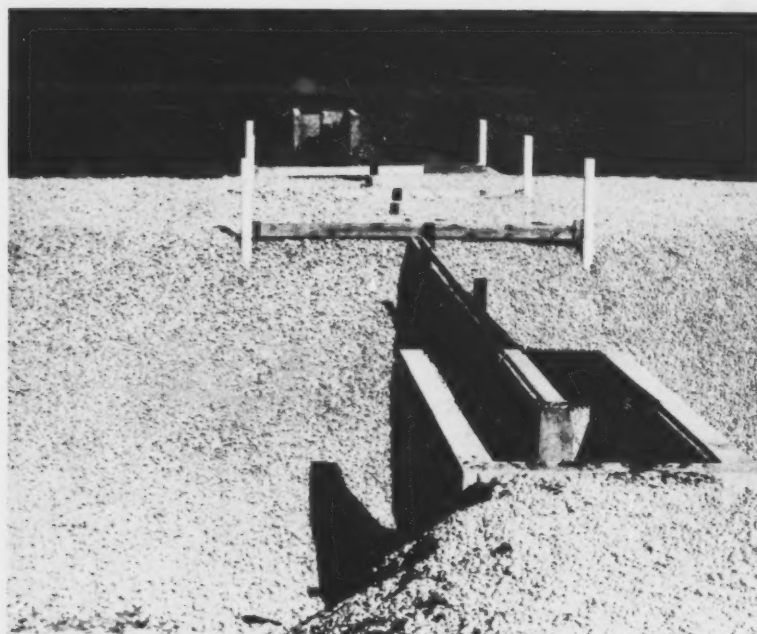


Figure 8. Rock filters looking from effluent end towards the influent end during construction.

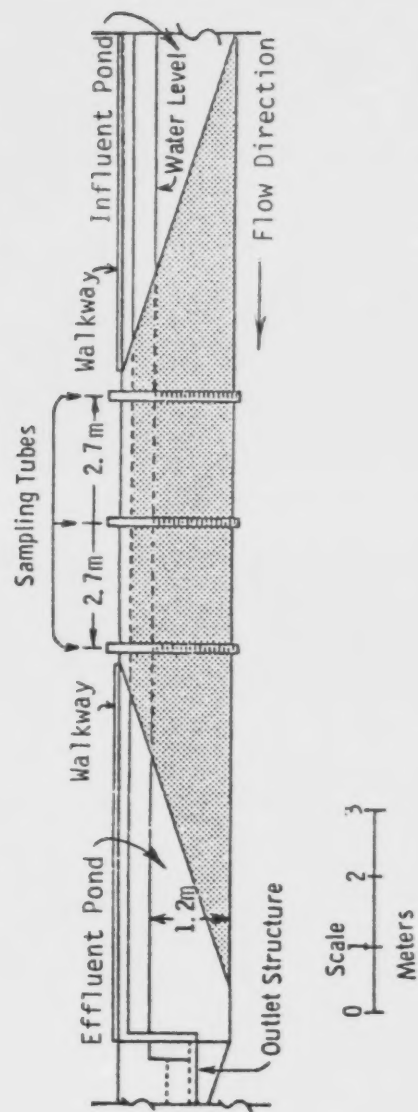


FIGURE 9. A CROSS SECTION OF THE ROCK FILTERS.

SECTION V

EXPERIMENTAL PROGRAM

The test facility was completed and placed into operation on January 4, 1974. Filling the test lagoon facility required approximately one week to January 10, 1974. Three sets of grab samples were collected each week from January 25, 1974 through May 16, 1975. Each set of grab samples were taken at the following locations:

1. effluent from Cell 3,
2. influent to rock filter lagoon,
3. effluents from each rock filter lagoon

Periodic samples were collected from the sample tubes within the two filters. The sample locations are shown by the stars in Figures 1 and 2.

Field data included measurement of flows into and out of the rock filter cells, temperature and dissolved oxygen. The initial temperature measurements were made with a mercury thermometer. After April 1, 1974, temperature measurements were made with a thermister in conjunction with the direct reading dissolved oxygen probe. No dissolved oxygen measurements were made in the field prior to April 1, 1974.

Chemical analyses were made for the following parameters:

1. pH
2. total suspended solids (TSS)
3. volatile suspended solids (VSS)
4. total chemical oxygen demand (COD)
5. soluble chemical oxygen demand
6. total biochemical oxygen demand (BOD₅)
7. soluble biochemical oxygen demand
8. alkalinity, as CaCO₃
9. ammonia nitrogen (NH₄⁺-N)

All of the chemical analyses were made according to the methods specified in the 13th edition of Standard Methods⁵ with the exception of ammonia nitrogen which was determined by means of a direct reading specific ion electrode⁶. Total phosphorus measurements, chlorophyll measurements and algal species identification counts were made from time to time.

Since the study was started in the middle of the winter, January, 1974, it was carried through the second winter and into the spring to determine the impact of cold weather both on startup and on normal operations. The data

collected during this study permitted not only direct evaluation of the rock filters in removing suspended solids but also permitted some evaluation of the characteristics of those suspended solids.

EUDORA LAGOON EFFLUENT

Samples of the effluent from Cell 3 were collected and analyzed from June 1, 1973 to give a better understanding of the effluent quality to be expected from this three cell lagoon system. The data collected from June 1, 1973, through December 12, 1973, indicated a range in suspended solids in the effluent from a low of 25 mg/l to a high of 183 mg/l. The median value during this period was 63 mg/l suspended solids. Only 5 percent of the 65 samples were under 30 mg/l. The high value of suspended solids, 183 mg/l, occurred in June with a sharp bloom of algae followed by rapid removal by predation of Daphnia and Cyclops. Six days after the 183 mg/l suspended solids concentration, the suspended solids were reduced to 25 mg/l. By and large the suspended solids fluctuated with changes in the microbial populations. A rise in suspended solids generally was observed to be related to an increase in algae as seen by routine microscopic examination. Detailed quantitative evaluation of the specific microorganisms was not made during 1973, only qualitative changes were observed. The routine microscopic examination of Cell 3 effluent indicated that a reduction in suspended solids was accompanied by an increase in predators and a decrease in algae populations. Detailed data on the suspended solids in Cell 3 effluent are given in Appendix A.

The BOD₅ data on Cell 3 effluent samples indicated a range from 12 mg/l to 46 mg/l with a median value of 23 mg/l. Approximately 79 percent of the 56 samples tested for BOD₅ showed less than 30 mg/l with only one sample above 45 mg/l. Soluble BOD₅ data ranged from 1 mg/l to 28 mg/l with a median value 6 mg/l. The data indicated that biodegradable organics were being removed from the Eudora wastewaters. The suspended BOD₅ data indicated a median active mass of approximately 21 mg/l volatile suspended solids. With 10 per cent inorganic suspended solids together with the 21 mg/l VSS, there were approximately 23 mg/l living mass of microbes in the 63 mg/l suspended solids.

The COD of the effluent from Cell 3 measured between 52 mg/l and 324 mg/l with a median of 124 mg/l. The soluble COD data showed a median value of 64 mg/l. Both the soluble BOD₅ and the suspended BOD₅ indicated that most of the soluble COD was non-biodegradable. Approximately 50 per cent of the suspended COD was non-biodegradable although 92 per cent of the effluent suspended solids were volatile solids.

Regular sampling of the experimental filters started on January 25, 1974. The data on the effluent from Cell 3 are presented in detail in Appendix A. Table 2 shows the monthly averages of the suspended solids, COD and BOD₅ data for the 16 months the project was operational. The suspended solids varied from a minimum of 36 mg/l in December, 1974, to a maximum of 73 mg/l in February, 1974. The average suspended solids concentration from Cell 3 was 60 mg/l with a median of 62 mg/l. The average volatile suspended solids was 48 mg/l, 80 per cent, with a median of 50 mg/l. The total COD

ranged from 92 mg/l to 144 mg/l with an average of 122 mg/l and a median of 130 mg/l. The soluble COD varied from a low of 44 mg/l to a high of 65 mg/l with an average of 53 mg/l. The suspended COD averaged 69 mg/l, giving a COD/VSS ratio of 1.44. The total BOD₅ averaged 21 mg/l with a low of 13 mg/l and a high of 34 mg/l. The median value of the BOD₅ was 16 mg/l. The soluble BOD₅ averaged 3.8 mg/l, indicating little biodegradable organics in the effluent. The normal BOD₅/COD ratio for the soluble organics indicated 46 mg/l non-biodegradable COD with 39 mg/l non-biodegradable suspended COD. Approximately 43 per cent of the suspended solids were active microbial solids based on biodegradability of the suspended solids. These data definitely indicated that the 3 cell lagoon was unable to meet the EPA effluent criteria for suspended solids and fell short of the BOD₅ criteria two months out of 16 months.

TABLE 2. MONTHLY AVERAGES OF CELL 3 EFFLUENT

Month	Total SS (mg/l)	Volatile SS (mg/l)	Total COD (mg/l)	Soluble COD (mg/l)	Total BOD ₅ (mg/l)	Soluble BOD ₅ (mg/l)
1974						
Feb.	73	59	143	44	30	7.3
Mar.	66	47	144	56	16	4.8
Apr.	47	33	99	65	20	4.5
May	54	41	102	52	16	3.5
June	52	40	96	45	13	3.0
July	57	44	92	49	14	3.6
Aug.	67	60	133	50	17	3.9
Sept.	63	53	124	52	16	3.9
Oct.	69	60	139	52	15	3.5
Nov.	60	52	130	53	15	1.7
Dec.	36	30	99	54	14	1.2
1975						
Jan.	50	41	112	54	22	3.6
Feb.	66	54	133	60	34	6.5
Mar.	71	60	136	54	33	3.5
Apr.	53	36	130	66	28	4.2
May	69	64	142	48	27	2.5
Average	60	48	122	53	21	3.8

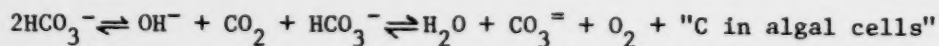
Table 3 presents the monthly averages of the temperature, dissolved oxygen, pH, ammonium-nitrogen, and total phosphorus. The water temperature

averaged 14°C with a monthly average ranging from 3°C to 29°C. From May through September, the water temperature was above 20°C while it was below 5°C from December through February. Temperature is very important in controlling the growth of microorganisms in the lagoon system.

TABLE 3. MONTHLY AVERAGES FROM CELL 3

Month	Water Temp. °C	Dissolved Oxygen (mg/l)	pH	NH ₄ ⁺ -N (mg/l)	Total P (mg/l)
1974					
Feb.	50	-	7.6	14	8.0
Mar.	10	-	7.8	12	6.5
Apr.	15	11.8	8.0	8.1	6.1
May	21	6.6	8.6	0.90	2.7
June	23	5.0	8.6	0.17	2.3
July	29	5.4	8.8	0.11	1.6
Aug.	25	6.1	8.8	0.48	1.8
Sept.	20	7.4	8.8	0.95	2.3
Oct.	15	8.7	8.7	0.81	3.4
Nov.	9	8.4	8.0	0.24	2.7
Dec.	4	15.7	8.5	0.44	3.1
1975					
Jan.	3	19.6	8.6	2.5	3.8
Feb.	3	15.4	8.7	2.8	3.0
Mar.	7	17.1	8.8	2.5	2.6
Apr.	14	9.8	9.0	1.0	1.6
May	22	13.0	9.2	0.41	0.9
Average	14	10.7	8.5	3.0	3.3

The dissolved oxygen in the effluent from Cell 3 was a minimum in June, 5.0 mg/l, and a maximum of 19.6 mg/l in January. The low temperature in January reduced biological activity while permitting greater oxygen solubility. The average monthly pH was 8.5 with a range from 7.6 to 9.2. The higher pH values were obtained when high algal metabolism removed the carbon from the bicarbonates to form hydroxide which forced some of the bicarbonates to carbonates.



The nutrients, nitrogen and phosphorus, follow the normal trend of metabolism. Ammonium nitrogen averaged 3.0 mg/l during this study, dropping

from 14 mg/l to 0.11 mg/l. The phosphorus averaged 3.3 mg/l and varied from 8.0 mg/l to 0.9 mg/l. Just prior to the start of data collection Cell 3 was the second cell in series since Cell 1 was used for fish culture. The flow pattern had been from Cell 2 to Cell 3. A heavy algae bloom during the summer of 1973 in Cell 2 resulted in the application of copper sulfate to control excess algal growths. The algae were killed off by the copper sulfate but not the bacteria. The net result was anaerobic metabolism and excessive odors. In an effort to control the odor nuisances Cell 1 was placed back into operation as part of the lagoon system during the fall of 1973. The high ammonium and phosphorus concentrations in February, 1974, reflected the nutrients which had accumulated in Cell 3 from the previous mode of operation. The ammonium nitrogen dropped to a minimum with metabolism in July 1974 and rose to a maximum at the end of the cold weather period in February. The phosphorus followed similar trends as the ammonium nitrogen but did not reach as low a level. Nitrogen was more of a limiting nutrient than phosphorus. The lagoon definitely showed that it could reduce both nitrogen and phosphorus to low levels during the warm summer months when maximum impact would be exerted on receiving streams.

ROCK FILTER INFLUENT

The effluent from Cell 3 was partially diverted into a wet well and pumped by a 2 HP submersible pump to the head end of the rock filter lagoon. A sample of influent was collected at the same time that the samples were collected of the effluent from Cell 3. The purpose of the second sample was to determine if a significant change occurred in the wet well and in the pipe between the wet well at the discharge from Cell 3 and the influent to the rock filter.

Detailed data for the chemical characteristics of the rock filter influent are given in Appendix B. A summary of the 16 month averages for both the effluent from Cell 3 and for the influent to the rock filters is given in Table 4. The data tend to indicate that little change occurred during the travel from the effluent of Cell 3 to the influent of the rock filter lagoon. The dissolved oxygen concentration dropped approximately 4.5 mg/l as might be expected since the microbes are retained in the dark without an opportunity for reaeration. The other chemical characteristics were essentially the same, being within normal variations for the analytical tests used.

Examination of the influent characteristics indicated a COD/VSS ratio of 1.53, close to normal for a biological wastewater treatment system. The 16 mg/l suspended BOD₅ indicated that approximately 47 per cent of the volatile suspended solids were living microbial solids. As one would expect 87 of the soluble COD was non-biodegradable. No special analyses were made to determine the chemical nature of the non-biodegradable COD. The ammonium nitrogen and phosphorus were in excess so that further microbial growth was possible.

The influent to the rock filters was discharged over two 15° V-notched weirs to provide sufficient depth of flow so that regular measurement of the influent flow rate was possible. The discharge from the two weirs was collected in the influent ponds in front of each rock filter. In effect,

the two systems were controlled at the same flow rate by adjustment of flow over the V-notched weirs. The purpose of the influent ponds in front of each rock filter was to provide a retention period for flow distribution across the face of the rock filters.

TABLE 4. MONTHLY AVERAGE CHEMICAL CHARACTERISTICS

Parameter (mg/l)	Effluent Cell 3	Influent Rock Filters	Effluent Large Rock Filter	Effluent Small Rock Filter
Suspended Solids	60	53	35	32
Volatile Suspended Solids	48	43	28	25
Total COD	122	119	96	89
Soluble COD	53	53	53	51
Total BOD ₅	21	20	17	15
Soluble BOD ₅	3.8	4.3	5.9	5.8
Ammonium Nitrogen	3.0	3.7	3.1	4.6
Total Phosphorus	3.3	3.6	3.7	3.8
Dissolved Oxygen	10.7	6.2	2.4	2.4
Temperature, °C	14	14	14	17
pH	8.5	8.4	8.1	8.1

The detention periods for the influent flows into the influent ponds are given in Table 5. It can be seen that the detention time in the influent pond for the large rock filter ranged from 0.3 to 1.9 days; while the detention time in the influent pond for the small rock filter ranged from 0.4 to 13.6 days. The effluent from the rock filters was collected in a small effluent pond prior to being discharged over a second set of 15° V-notched weirs into the outlet structure. The theoretical liquid detention times in the effluent ponds for both the large rock and the small rock filters are also given in Table 5.

LARGE ROCK FILTER

The influent to the large rock filter passed through the influent pond onto the surface of the rock filter and then through the void spaces around the rocks out into the effluent pond following the rock filter. For purposes of evaluating the rock filters, it was decided to base the hydraulic loading on a volumetric basis, $l/m^3/day$ ($gal/ft^3/day$) rather than on a surface area basis. The volumetric loading basis was believed to give a better estimation of the total potential load on the rock filter since the suspended solids would fill up the total void spaces in the rock filter and not just the surface area. The volumetric loadings for the large rock filter are given in Table 5.

TABLE 5. HYDRAULIC LOADINGS AND DETENTION TIMES IN EACH FILTER SYSTEM

<u>Large Rock Filter</u>					
Month		Influent Pond Detention Time	Filter		Effluent Pond Detention Time
		Days	Hydraulic Loading 1/m ³ /day	Loading gal/ft ³ /day	Days
Feb	1974	1.2	850.8	6.4	0.8
Mar		1.8	551.1	4.1	1.2
Apr		1.2	870.1	6.5	0.8
May		0.8	1216.8	9.1	0.6
Jun		0.7	1546.9	11.6	0.4
Jul		1.5	676.8	5.1	1.0
Aug		1.2	812.1	6.1	0.8
Sep		0.3	2977.8	22.3	0.2
Oct		0.5	1856.3	13.9	0.4
Nov		1.0	986.2	7.4	0.7
Dec	1-17	1.3	781.2	5.6	0.9
Dec	18-31	0.5	2088.3	15.7	0.3
Jan	1975	0.5	1838.9	13.8	0.4
Feb		1.8	572.4	4.3	1.2
Mar		1.9	535.6	4.0	1.2
Apr		0.8	1278.4	9.6	0.5
May		1.0	1030.7	7.7	0.7
<u>Small Rock Filter</u>					
Feb	1974	1.0	878.6	6.6	0.7
Mar		1.3	637.4	4.7	1.0
Apr		0.9	930.3	7.0	0.7
May		0.8	1050.9	7.9	0.6
Jun		0.6	1378.2	10.3	0.4
Jul		1.2	706.3	5.3	0.9
Aug		1.9	447.9	3.6	1.4
Sep		0.4	2187.9	16.4	0.3
Oct		0.8	1085.3	8.1	0.6
Nov		1.6	516.8	3.9	1.2
Dec	1-17	13.6	62.0	0.5	9.8

The hydraulic flow rate to the rock filter was increased steadily until June, 1974, when a power outage resulted in a short shutdown for several days. Efforts were made to keep the pilot plant in continuous operation but periodic thunderstorms during the summer and fall of 1974 resulted in five periods of power outages. These power outages are typical for small wastewater treatment systems in Kansas where severe thunderstorms result in periodic power failures. Fortunately, most wastewater treatment plants have automatic power reset circuits. The pilot plant was not designed for automatic power reset; but rather had manual reset switches which were activated by the sampling crews when they collected samples for analysis.

The analytical data collected from the samples of effluent from the rock filter are given in Appendix C. Plots of the total suspended solids data for the influent and for the effluent samples from the large rock filter are shown in Figure 10. The data have been plotted as a 3 point running average to smooth out the sharp variations that occurred from time to time as a result of a single sample. Use of the running averages permits easier evaluation of the large number of data points as far as trends are concerned.

The influent suspended solids to the rock filters showed a very rapid increase at the end of February, 1974, when the water temperature began to increase. A very heavy growth of Chlorella resulted initially and was followed by a heavy growth of both Moine and Daphnia. The large rock filter did not have an effect on Chlorella, which passed right through the voids. The suspended solids dropped to their lowest level in March as the Daphnia stripped out all the Chlorella. Once the Chlorella were removed, the Daphnia decreased rapidly. This was the only time there was a large bloom of either Chlorella or Daphnia during the course of this study.

The removal of the Chlorella by the middle of March left considerable ammonium nitrogen and phosphorus in Cell 3. The low suspended solids in Cell 3 permitted good light penetration which stimulated the growth of other species of algae. The suspended solids quickly rose as the new species of algae grew up. There was a slow but steady removal of algae in the large rock filter. By the end of May the large rock filter was showing a significant removal of algae.

As indicated earlier, a series of five power outages occurred during the summer and fall of 1974. Each time a power outage occurred, the efficiency of the rock filter for removing suspended solids declined for a short period. The best removal of suspended solids occurred during the warm, summer months. Examination of the submerged rock indicated the rock surfaces were coated with microbial growth, much like a trickling filter. It appeared that part of the removal of algae was by adsorption onto the microbial slime layer on the large rock media.

The onset of cooler weather in November and December resulted in a decrease in algae in the influent and in the removal of algae. The filter operation during spring, 1975, was similar to that during spring, 1974, except there was no major bloom of Chlorella in 1975 as there was in 1974. The winter of 1974-75 had less snow than the winter of 1973-74, permitting better light penetration and more uniform algal growth rather than a sudden

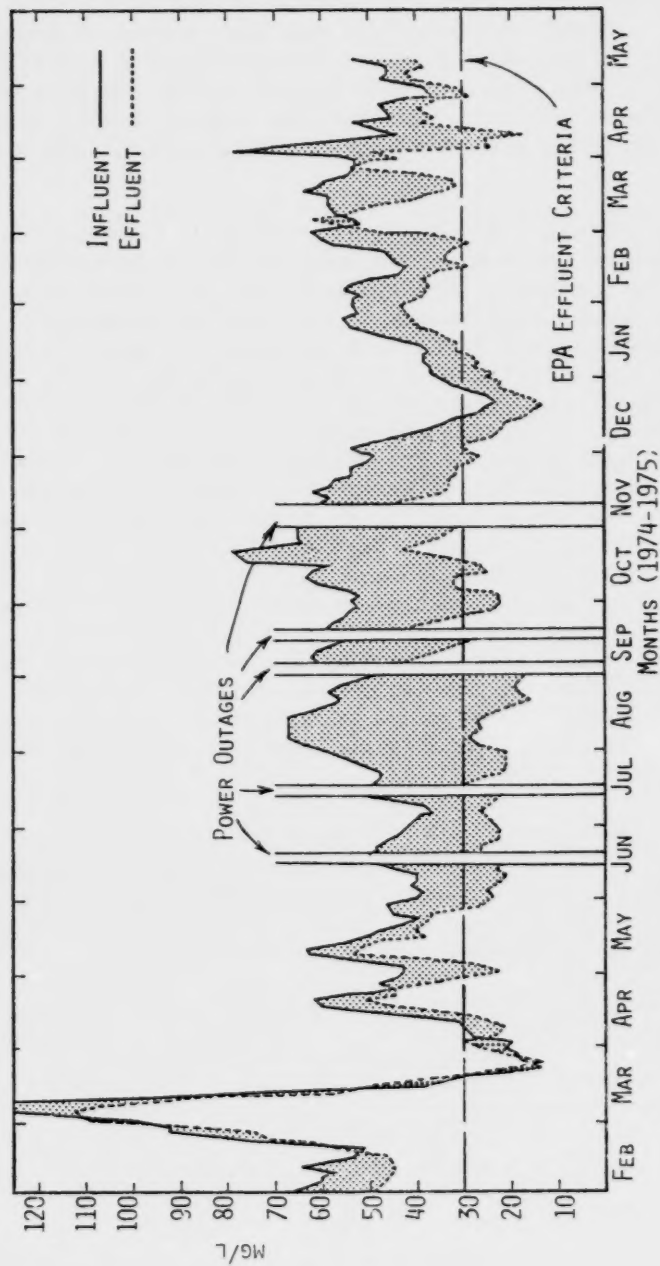


FIGURE 10. INFLUENT AND EFFLUENT SUSPENDED SOLIDS FROM THE LARGE ROCK FILTER SYSTEM.

bloom when conditions became favorable.

The total BOD₅ data are presented in Figure 11. As with the suspended solids data, the BOD₅ data are plotted as a 3 point running average. The data show little BOD₅ reduction and periods of increased BOD₅ in the effluent. The low BOD₅ of the influent reflected the high degree of treatment provided by the Eudora lagoon system. The data in appendices A and B indicated that most of the BOD₅ in the effluent from Cell 3 and in the influent to the rock filters was suspended BOD₅, probably in the form of living microbial cells. During warm weather BOD₅ data decreased, rising during cold weather, as would be expected.

The soluble COD data, Figure 12, showed little change once the system settled down. During the summer the soluble COD in the effluent exceeded the soluble COD in the influent. For the most part the variations in soluble COD data were within normal variations in sampling and analysis. The major change in the data across the rock filter can be seen in Figure 13, a plot of the dissolved oxygen concentrations in both the influent to the large rock filter and in its effluent. The drop in dissolved oxygen across the rock filter is a good indication of biological activity within the filter. It appeared that the lack of dissolved oxygen in the influent during the summer months limited aerobic metabolism within the filter. It was not until December, 1974 that the effluent from the large rock filter showed sufficient dissolved oxygen for the reactions to be aerobic. There was 9.8 mg/l dissolved oxygen change across the rock filter in December and 10.4 mg/l change in January, 1975. Needless to say, the lack of sufficient dissolved oxygen in the rock filter influent resulted in anaerobic conditions within the rock filter. The ammonium nitrogen change across the rock filter, as plotted in Figure 14, showed a slight increase during the summer months. These data tended to indicate some biological degradation within the filter. During the cooler periods there was an uptake in nitrogen, indicating growth of microorganisms within the rock filter.

Data collected from the samples taken from the sampling tubes within the large rock filter are presented in Appendices F and G. The changes in chemical characteristics were small with only the dissolved oxygen showing a significant change. Table 6 shows the change in dissolved oxygen through the large rock filter for a typical warm month and a typical cold month.

TABLE 6. DISSOLVED OXYGEN CONCENTRATIONS ACROSS LARGE ROCK FILTER

D.O. (mg/l)	Influent	Sampling Tube in Rock Filter			Effluent
		Upstream	Center	Downstream	
June, 1974	3.5	1.3	0.0	0.0	0.1
Jan., 1975	15.4	12.6	8.4	2.2	5.0

The dissolved oxygen change through the rock filter reflected the biological activity that occurred within the filter. In June, 1974, the dissolved oxygen was quickly removed in the front section of the rock filter. As the temperature decreased, the influent dissolved oxygen increased as indicated

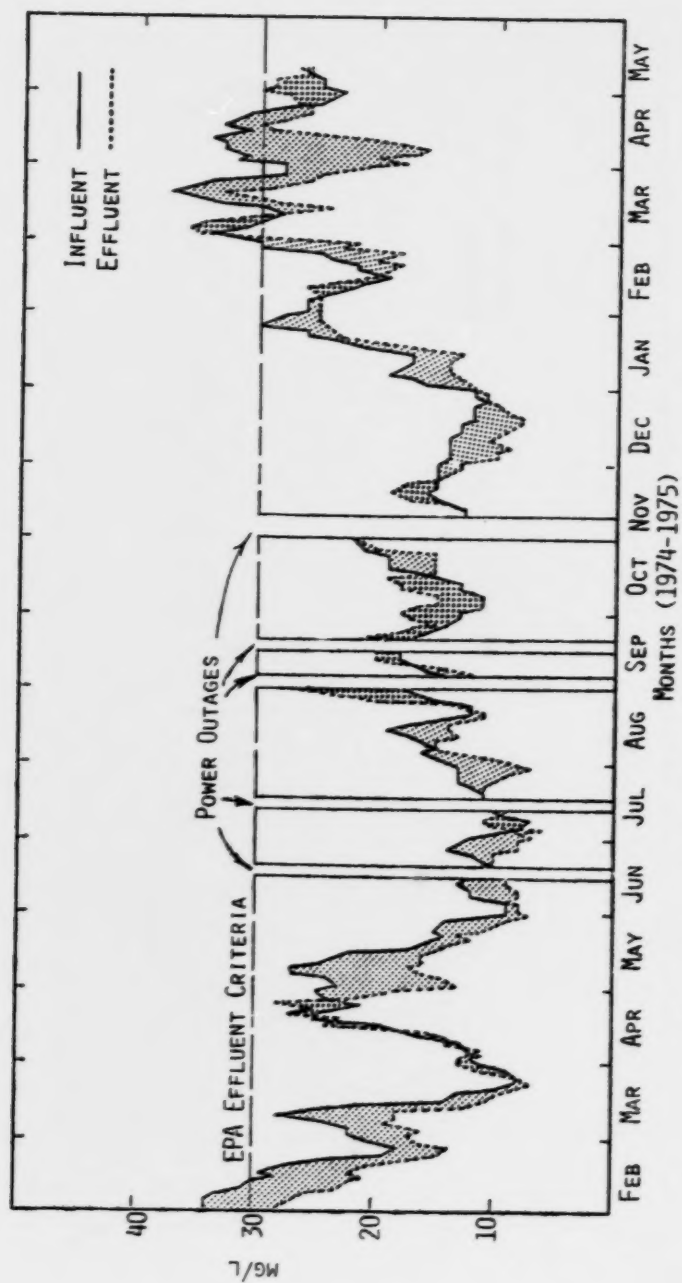


FIGURE 11. Total BOD₅ DATA FOR THE LARGE ROCK FILTER SYSTEM.

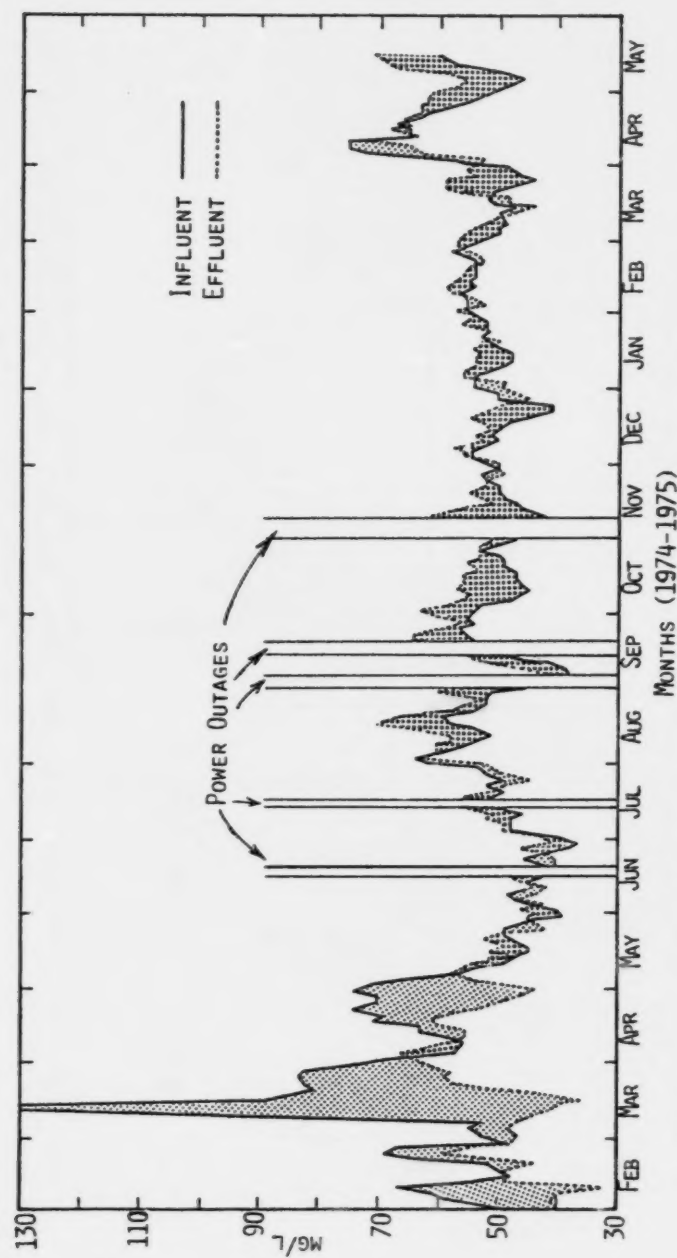


FIGURE 12. SOLUBLE COD DATA FOR THE LARGE ROCK FILTER SYSTEM.

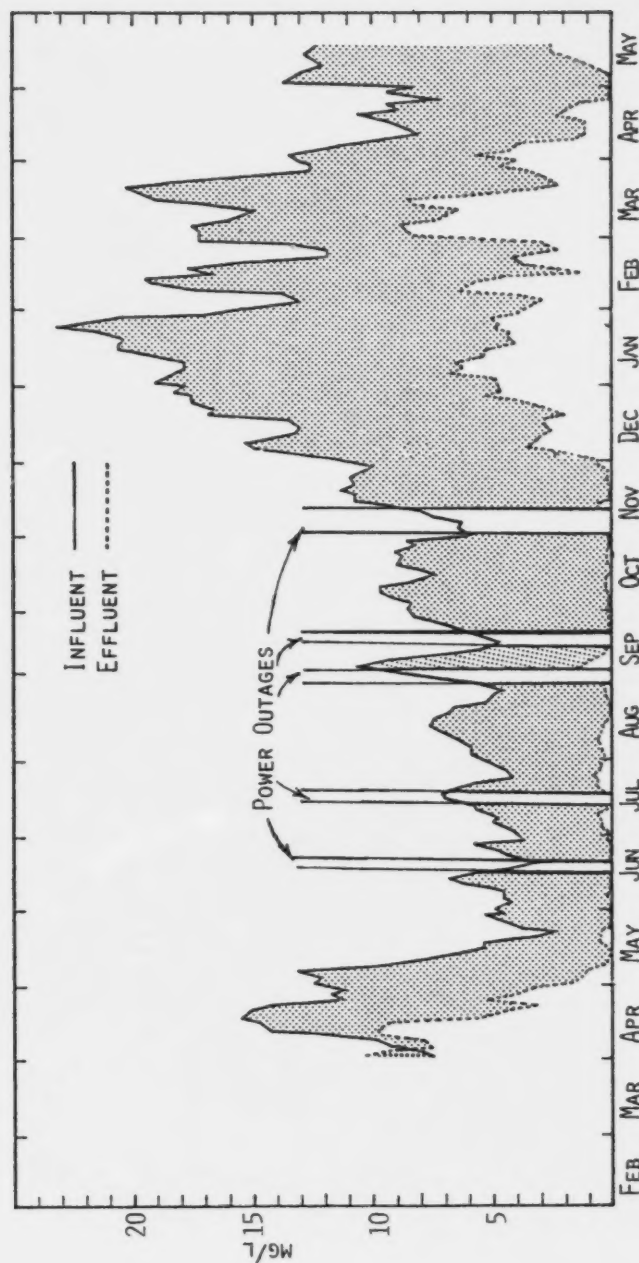


FIGURE 13. DISSOLVED OXYGEN DATA FOR THE LARGE ROCK FILTER SYSTEM.

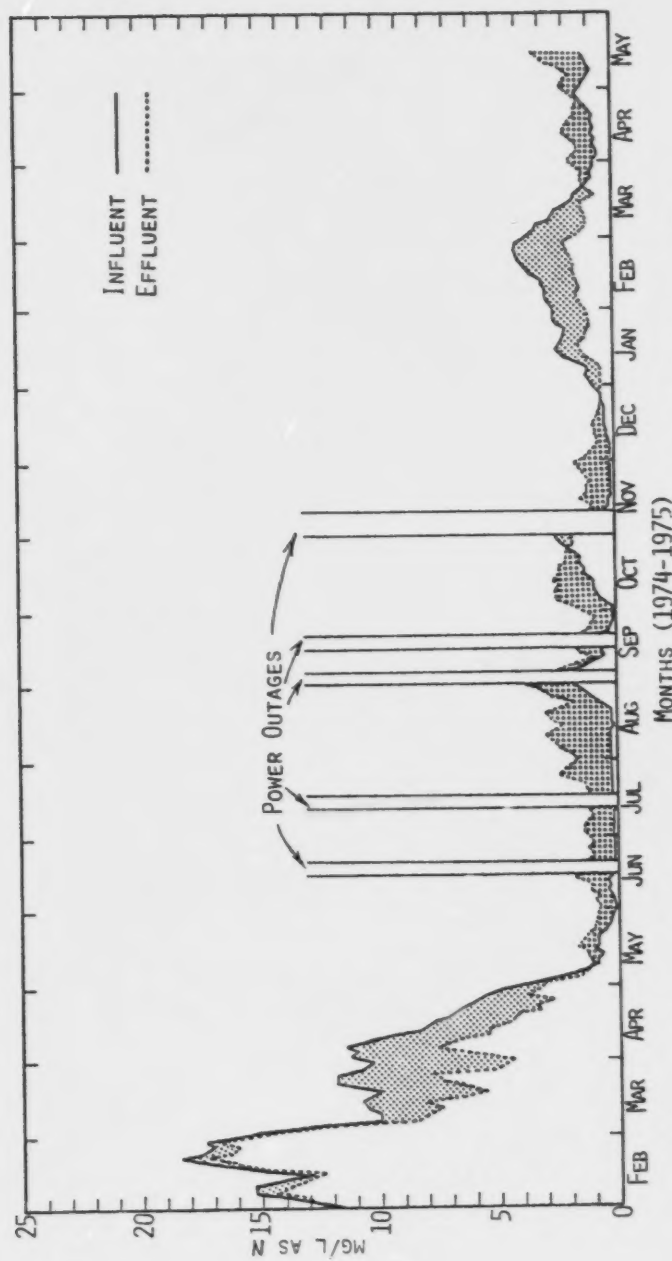


FIGURE 14. AMMONIUM NITROGEN DATA FOR THE LARGE ROCK FILTER SYSTEM.

by the data for January, 1975. The dissolved oxygen dropped rapidly through the center of the rock filter, decreasing an average of 10.4 mg/l over a distance of 5.4 m. The drop in dissolved oxygen indicated good biological activity even during the cold periods. The rise in dissolved oxygen was a result of algal growth in the effluent pond section of the experimental rock filter lagoon. These data pointed to the importance of dissolved oxygen in stabilizing the organic matter removed by the rock filter.

SMALL ROCK FILTER

The data on the chemical analyses of the samples collected from the small rock filter are given in Appendices D, E and G. Monthly averages for samples collected during the 16 months of this study are given in Table 4. It can be seen that the small rock filter gave slightly better removals of suspended solids, COD and BOD₅ than the large rock filter, but the differences were within experimental variations of sampling and analysis. Table 5 gives the hydraulic loading data on the small rock filter. The decreased flow rate in August, 1974, was the result of increased head loss through the small rock filter. A leak occurred in the baffle wall between the two rock filters in May and resulted in increased flow to the large rock filter. The data in Table 5 reflects the effect of the leak on the flows through both rock filters. Heavy growths of algae occurred on the backside of the small rock filter the first of December, essentially stopping flow through the filter. The backside of the small rock filter was thoroughly raked to dislodge the algae. The algal growths were too dense to unclog the filter. On December 17, 1974, the small rock filter was taken out of service after 11 months of operations.

The suspended solids data for the influent and the effluent samples from the small rock filter are plotted in Figure 15. Unlike the data plots for the large rock filter, all of the individual data points are given in Figure 15. These data show the sharp variations of the individual data points rather than the smoother data points using 3 day running averages. The power outages affected the small rock filter operations the same as the large rock filters. Good suspended solids reductions occurred in October, 1974, just before the final power outage and clogging of the filter.

The BOD₅ changes across the small rock filter are shown in Figure 16. The overall BOD₅ reduction averaged 5 mg/l. It can be seen that more BOD₅ appeared in the effluent in October than was in the influent. The surface raking of the backside of the small rock filter in December resulted in a sharp increase in effluent BOD₅. The ammonium nitrogen data plotted in Figure 17 showed a release of ammonium nitrogen from May, 1974, on until the filter clogged in December. The data in Table 4 indicated an overall increase of ammonium nitrogen of 0.9 mg/l.

The changes in dissolved oxygen across the small rock filter was a good measure of biological activity within the filter. Table 7 shows the changes in dissolved oxygen through the small rock filter.

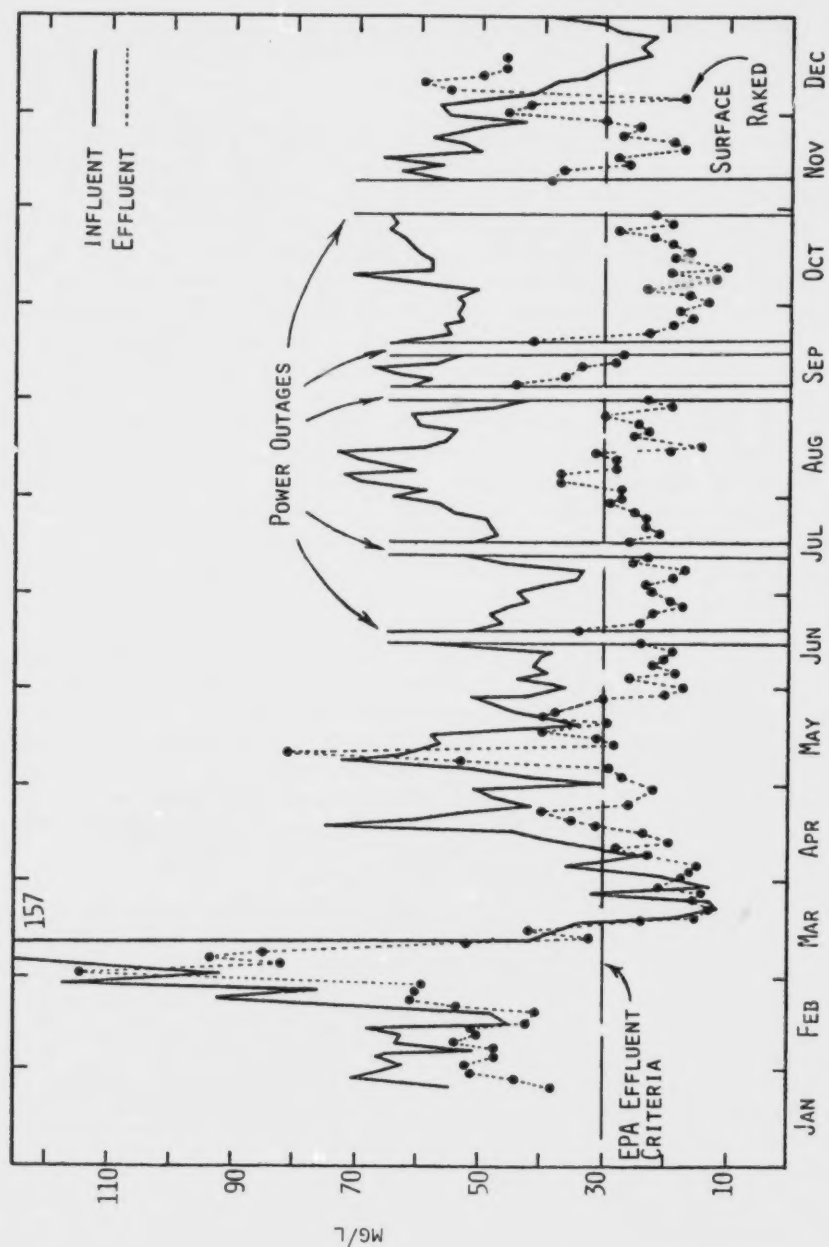


FIGURE 15. SUSPENDED SOLIDS SMALL ROCK FILTER.

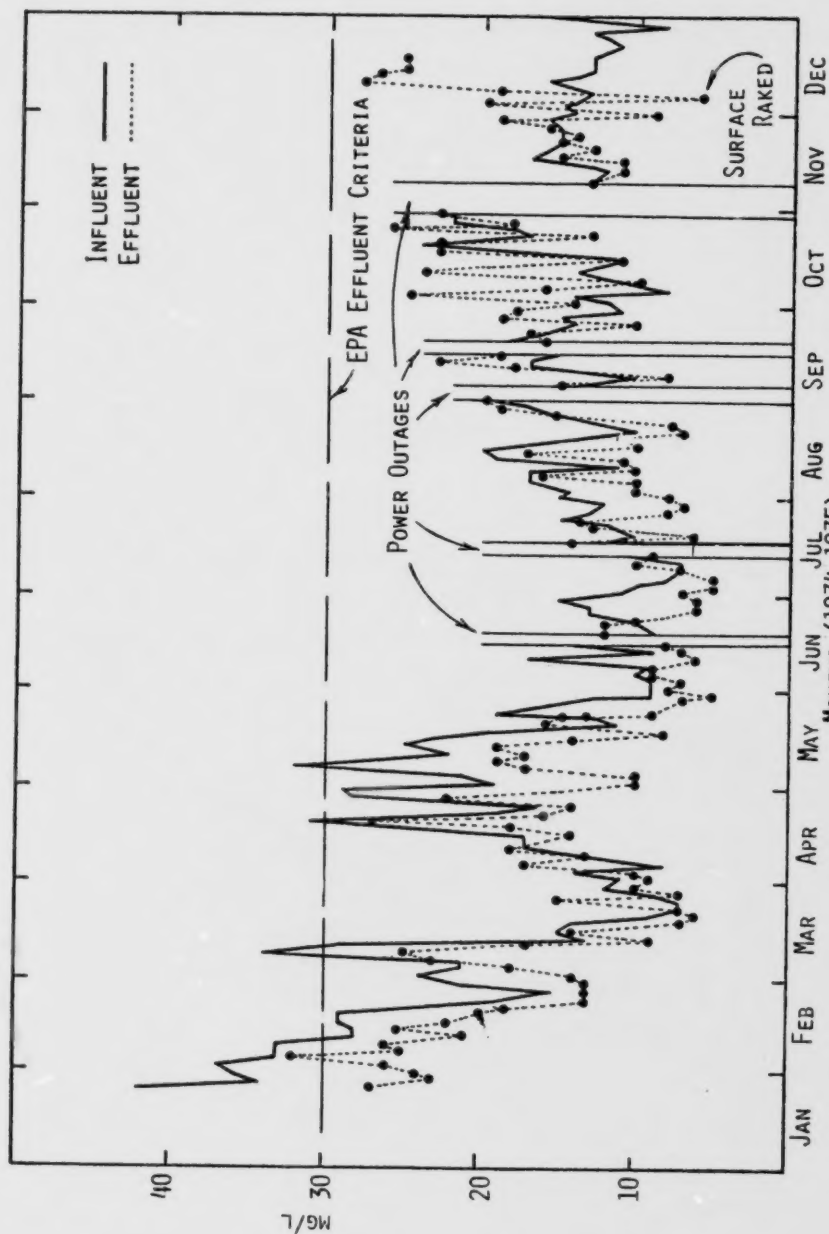


FIGURE 16. TOTAL BOD₅ SMALL ROCK FILTER.

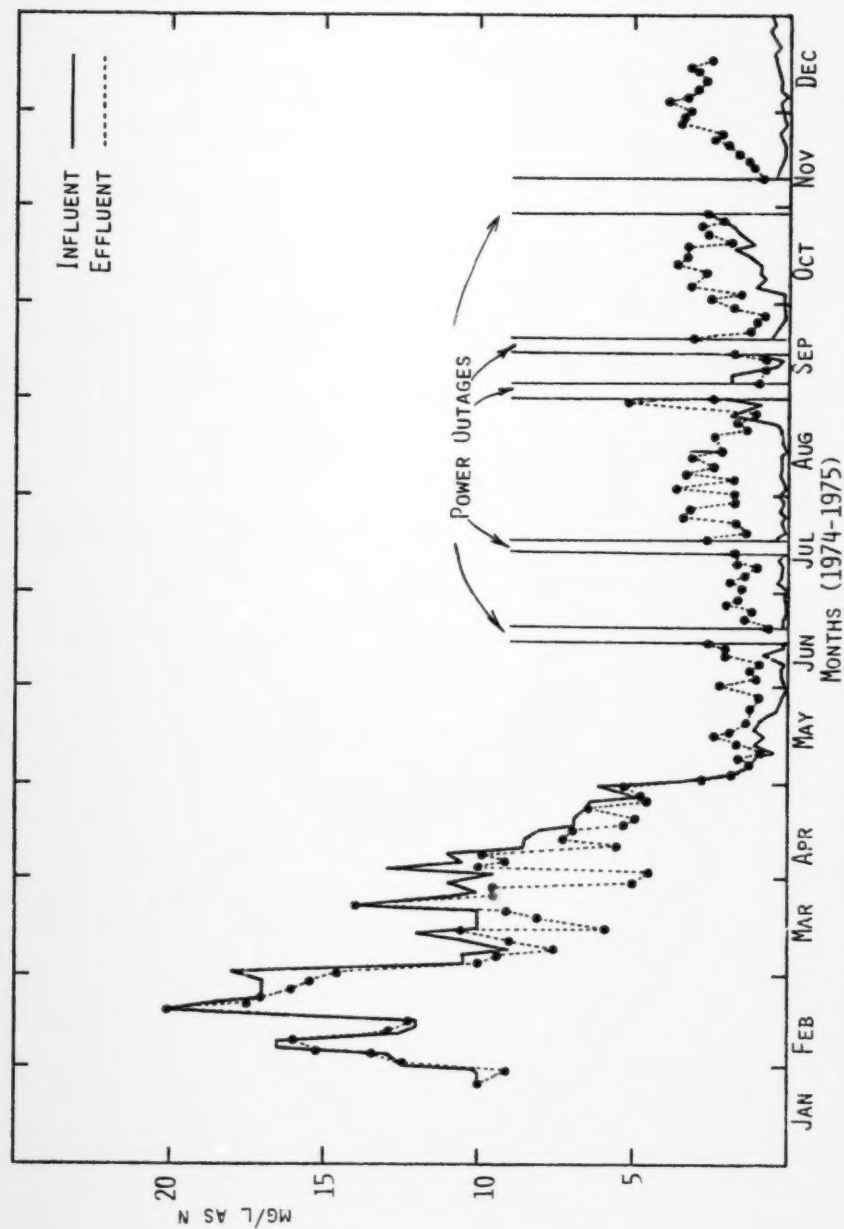


FIGURE 17. AMMONIUM NITROGEN DATA FOR THE SMALL ROCK FILTER SYSTEM.

TABLE 7. DISSOLVED OXYGEN CONCENTRATIONS ACROSS SMALL ROCK FILTER

D.O. (mg/l)	Influent	Sampling Tube in Rock Filter			Effluent
		Upstream	Center	Downstream	
June, 1974	3.5	3.4	0.0	0.0	0.1
Nov., 1975	8.7	9.1	2.7	0.3	3.4

The dissolved oxygen concentrations did not change significantly from the influent to the upstream sampling tube; but did show a sharp change in the 2.7m distance between the upstream sampling tube and the center sampling tube. The June, 1974, samples showed the need for additional oxygen. Even the November, 1974, samples showed a need for more oxygen as the 0.3 mg/l in the downstream tube was quite low. Again, the algae on the small rock filter surface and in the effluent pond after the rock filter helped increase the dissolved oxygen in the effluent. The sampling tubes within the rock filter helped show that the change in dissolved oxygen through the rock filter was greater than indicated by the differences between the influent and the effluent values.

CHLOROPHYLL AND ALGAE

In an effort to obtain a better understanding of the nature of the suspended solids in the different samples, chlorophyll extractions and algal counts were made over part of the study period. The chlorophyll extractions were designed to give a relative measure of the active fraction of algae. The measurements were made for chlorophyll a, chlorophyll b and chlorophyll c. Chlorophyll a is found in all algae while chlorophyll b occurs in green algae and chlorophyll c occurs in diatoms. The data on the chlorophyll concentrations are given in Appendix H. Table 8 shows the concentrations of chlorophyll a through the various units when the effluent from Cell 3 was at maximum, minimum and median values. Since the maximum chlorophyll a value was measured after the small rock filter clogged, a second maximum value was taken when both rock filters were in operation. The maximum value of 913 µg/l chlorophyll a occurred on March 19, 1975, when the algae began to grow in the spring. There was a definite drop in the chlorophyll a concentration in the rock filter influent; but the samples collected over the next few days reflected the retention of chlorophyll a in the pipe from the end of Cell 3 to the influent pond of the rock filter lagoon. The high concentration of chlorophyll a in the effluent from the large rock filter was indicative of regrowth of algae in the effluent pond of the rock lagoon as the downstream tube within the large rock filter showed much less chlorophyll a.

The data for October 12 showed chlorophyll a concentrations were quite similar for Cell 3 and the rock filter influent. The large rock filter gave a definite reduction in chlorophyll a, 62 per cent, with the same concentration in the downstream tube as in the final effluent. The small rock filter removed more chlorophyll a than the large rock filter.

The minimum value of chlorophyll a occurred on July 5, 1974. Cell 3

effluent had 45 µg/l while the rock filter influent showed only 16 µg/l concentration. It appeared that some of the chlorophyll was retained temporarily in the pipe between Cell 3 and the rock filter lagoon the same as it did in February. The median value of chlorophyll a was obtained on November 12, 1974. Half of the time the chlorophyll a concentration was below 177 µg/l. The drop in chlorophyll a between Cell 3 and the rock filter lagoon was rather small. The large rock filter gave 47 per cent reduction in chlorophyll a, while the small rock filter had 57 per cent reduction with obvious regrowth. The small rock filter was removing even more chlorophyll as evidenced by the concentration in the downstream sampling tube.

TABLE 8. CHLOROPHYLL A THROUGH ROCK FILTER SYSTEM

	Date	Chlorophyll a in µg/l			
		Cell 3 Effluent	Rock Filter Influent	Large Rock Filter Effluent	Small Rock Filter Effluent
Minimum	July 5, 1974	45	16	31	20
Maximum	Oct. 12, 1974	429	388	(135)147	(78) 46
	Mar. 19, 1975	913	308	(238)643	
Median	Nov. 12, 1974	177	157	(103) 84	(24) 68

() denotes concentration in downstream sampling tube within the rock filters.

It has been estimated that chlorophyll a concentrations range from 0.1 to 0.3% dry weight of the algae. This would mean that Cell 3 effluent should have had between 15 and 45 mg/l algae on July 5, 1974. The measured suspended solids were 45 mg/l. The October 12, 1974 data would have indicated from 140-430 mg/l algae but the suspended solids were only 60 mg/l. The November 12, 1974 data indicated from 60 to 180 mg/l algae with 71 mg/l suspended solids. The March 19, 1975 data showed even greater error. The chlorophyll a data indicated between 300 and 910 mg/l algae while the suspended solids data were only 113 mg/l. These results show the danger in using gross factors between a small concentration of chlorophyll and suspended solids. It suffices that chlorophyll concentrations give a general measure of the algae potential but should be used with caution as to specific quantitative relationships to algae mass.

For convenience, the algae were placed into four general groups:

1. Blue-green
2. Green
3. Diatoms
4. Flagellates

The specific number of algae in one ml of sample were estimated from routine microscopic counts using a calibrated counting cell. Appendices J to O shows the algae counts for the samples taken during this study. The major algae identified were Oscillatoria, Chlorella, Scenedesmus, and Nitzschia. Table 9 summarizes the algae counts for these predominant algae in the

TABLE 9. PREDOMINANT ALGAE IN CELL 3 EFFLUENT

Date	<u>Oscillatoria</u>	1000 cells/ml <u>Chlorella</u>	<u>Scenedesmus</u>	<u>Nitzschia</u>
1974				
June	19,800	178,000	5,300	6,700
July	13,700	107,000	970	3,000
Aug.	23,800	103,000	2,700	9,600
Sept.	23,000	50,200	2,100	2,100
Oct.	28,100	30,600	2,700	4,600
Nov.	32,200	42,500	6,900	10,800
Dec.	10,700	32,000	15,000	5,250
1975				
Jan.	0	41,900	41,500	25
Feb.	0	35,800	33,600	0
Mar.	0	61,900	42,200	500

TABLE 10. PREDOMINANT AGLAЕ IN ROCK FILTER INFLUENT

Date	<u>Oscillatoria</u>	1000 cells/ml <u>Chlorella</u>	<u>Scenedesmus</u>	<u>Nitzschia</u>
1974				
June	28,200	176,000	5,000	7,800
July	11,400	76,600	4,100	940
Aug.	28,000	60,000	920	2,700
Sept.	-	15,300	720	780
Oct.	37,800	30,600	3,000	5,200
Nov.	29,400	47,300	9,600	9,100
Dec.	9,900	52,100	16,300	5,200
1975				
Jan.	450	42,800	40,100	590
Feb.	0	43,600	46,000	0
Mar.	1,280	42,300	27,000	910

TABLE 11. PREDOMINANT ALGAE IN LARGE ROCK FILTER EFFLUENT

Date	1000 cells/ml			
	<u>Oscillatoria</u>	<u>Chlorella</u>	<u>Scenedesmus</u>	<u>Nitzschia</u>
1974				
June	29,400	198,000	690	1,100
July	310	22,000	2,800	2,300
Aug.	2,400	19,600	2,200	220
Sept.	9,200	12,600	1,000	1,000
Oct.	17,100	13,600	2,400	3,200
Nov.	16,000	19,800	1,400	1,900
Dec.	4,200	28,300	12,600	4,100
1975				
Jan.	2,700	37,000	28,200	0
Feb.	0	29,600	27,500	2,000
Mar.	740	41,800	14,500	1,800

TABLE 12. PREDOMINANT ALGAE IN SMALL ROCK FILTER EFFLUENT

Date	1000 cells/ml			
	<u>Oscillatoria</u>	<u>Chlorella</u>	<u>Scenedesmus</u>	<u>Nitzschia</u>
1974				
June	6,200	208,000	300	1,300
July	320	24,700	3,100	520
Aug.	230	13,000	88,200	380
Sept.	8,200	11,600	980	560
Oct.	8,400	4,800	520	990
Nov.	6,400	14,700	860	1,400
Dec.	0	8,400	3,300	1,200

samples from Cell 3. The Oscillatoria counts were low as they represented fragments of several cells. It was not possible to count individual cells of this filamentous blue green algae. Oscillatoria counts dropped to a minimum in June and then rose to a maximum in November before cold weather dropped the Oscillatoria out of the effluent. Chlorella, a tiny, non-motile, green algae was a maximum in June and dropped to a minimum in October before starting a steady climb to the end of the study. Scenedesmus counts were low in the summer and rose during the cold weather. The diatom, Nitzschia showed a series of oscillations during the warm weather and then dropped off with cold weather. The number of specific flagellated algae were not high enough to be a major factor in the total algal population.

The influent samples to the rock filter were similar to the samples from Cell 3 as far as algae counts were concerned. There was some variation as would be expected for differences in sampling techniques and normal counting variations. The data for the algae counts in the rock filter influent are given in Appendix K. The algae counts are summarized on a monthly average in Table 10. Large rock filter effluent data on algae counts are given in Appendices L and M with monthly averages presented in Table 11. The data indicated good removal of Oscillatoria. Chlorella reductions were greatest in the summer and fall. There were moderate reductions in Scenedesmus and Nitzschia.

The small rock filter data are presented in Appendices N and O. Monthly averages for predominant algae are given in Table 12. It can be seen that the reduction in algae was greater in the small rock filter than in the large rock filter. The only unusual occurrence was a sudden bloom of Scenedesmus in the effluent pond of the small rock filter system in August.

Both the algae counts and the chlorophyll a data showed that the rock filters were removing a large fraction of the algae applied to the rock filters. The algae and chlorophyll a reduction data agreed with the suspended solids reduction data given in Table 4. Even though specific reduction factors were not readily apparent, the reductions were similar.

Because of the importance of alkalinity for the growth of algae, data were collected on alkalinity through the filters from July 19, 1974 to the end of the study. The detailed data for alkalinity are presented in Appendix I. There were very little changes in the alkalinity over the period of analysis. Table 13 gives a summary of the total alkalinity data.

TABLE 13. TOTAL ALKALINITY THROUGH ROCK FILTER LAGOON SYSTEM

	Alkalinity, mg/l as Ca CO ₃		Sampling Tubes		
	Influent	Upstream	Center	Downstream	Effluent
Large Rock Filter	264	261	260	(275)	268
Small Rock Filter	255	255	260	(269)	275

The apparent rise in alkalinity appears to be within experimental variation

for this set of data. The small number of data points, only 5, for the downstream sampling tubes makes it impossible to compare these data with the other data. The small rock filter had less data than for the large rock filter which resulted in greater variations in the data. Although the pH changed from 8.4 to 8.1 the change was not sufficient to affect the alkalinity forms. Essentially, the alkalinity was bicarbonate alkalinity with little free carbon dioxide. There did not appear to be sufficient metabolism in the filter to change the alkalinity.

SECTION VI

DISCUSSION OF RESULTS

The Eudora wastewater lagoon was loaded to approximately 55 per cent of design capacity during this study. The three cell lagoon had a 246 day retention period, more than adequate for a high degree of treatment for municipal wastewaters. As shown in Table 2 Cell 3 produced an effluent relatively high in suspended solids, averaging 60 mg/l total suspended solids with 48 mg/l volatile suspended solids. The effluent had little soluble BOD₅, averaging only 3.8 mg/l. The total BOD₅ averaged 21 mg/l, giving 17 mg/l suspended BOD₅. The COD in the effluent from Cell 3 averaged 122 mg/l with 53 mg/l soluble COD. The suspended COD to volatile suspended solids ratio was 1.44 mg COD/mg VSS, typical for mixed microbial solids. The microscopic examinations of the effluent indicated that the suspended solids were a mixture of living microbial cells and dead cells. The suspended BOD₅ indicated that approximately 43 per cent of the volatile suspended solids were living cells. In effect, the long retention time in the lagoon resulted in a continuous recycling of nutrients through the algae. The fine suspended solids were easily maintained in suspension by periodic wind action across the surface of the lagoon. The data collected on the effluent from Cell 3 showed the importance of the suspended solids in determining the overall effluent quality from a facultative, lagoon treating municipal wastewaters. If the suspended solids could be reduced to a point where they met EPA effluent criteria, the effluent BOD₅ would also be below EPA criteria.

The rock filters were constructed to demonstrate the ability of the rock filters to remove suspended solids. Figure 18 is a plot of the quantity of suspended solids removed through both filters. The data for both filters is quite similar with the removal showing a steady rise through the summer of 1974. The small rock filter clogged in December and was stopped before the study was completed. The large rock filter showed a drop in suspended solids removal during the winter with a leveling off during the spring of 1975. The removal of suspended solids ranged between 10 and 15 mg/l.

The removal of BOD₅ through the rock filters is shown in Figure 19. The change in BOD₅ was low, almost within the experimental error of the analytical techniques. The BOD₅ reduction increased through March and then decreased to October when removal increased again. The data for suspended solids removal and BOD₅ removal did not correlate very well indicating some changes through the rock filters. The suspended BOD₅ data indicated the volatile suspended solids from the large rock filter effluent were 68 per cent living microbial mass. The small rock filter data indicated its effluent contained 63 per cent living microbial mass. The influent to both rock filters averaged 63 per cent living microbial mass. It appeared the rock

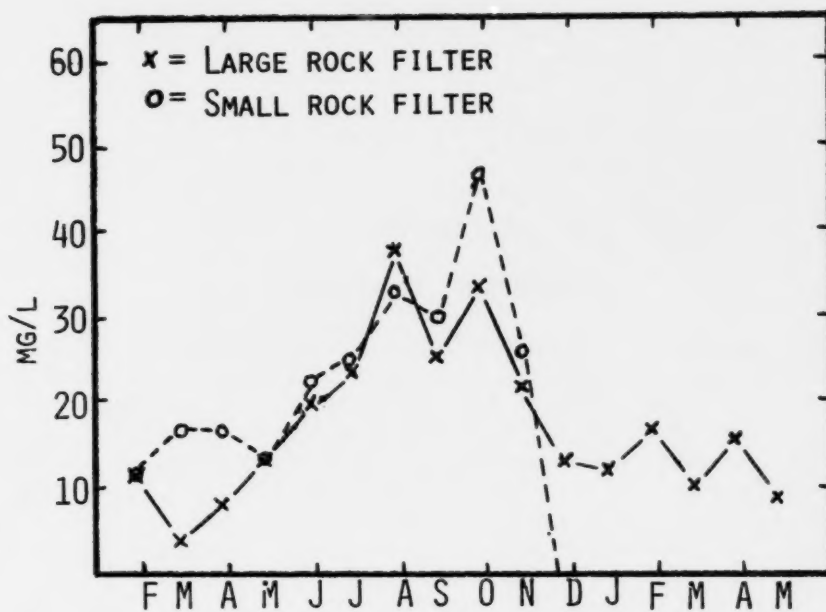


FIGURE 18. SUSPENDED SOLIDS REMOVED IN ROCK FILTERS.

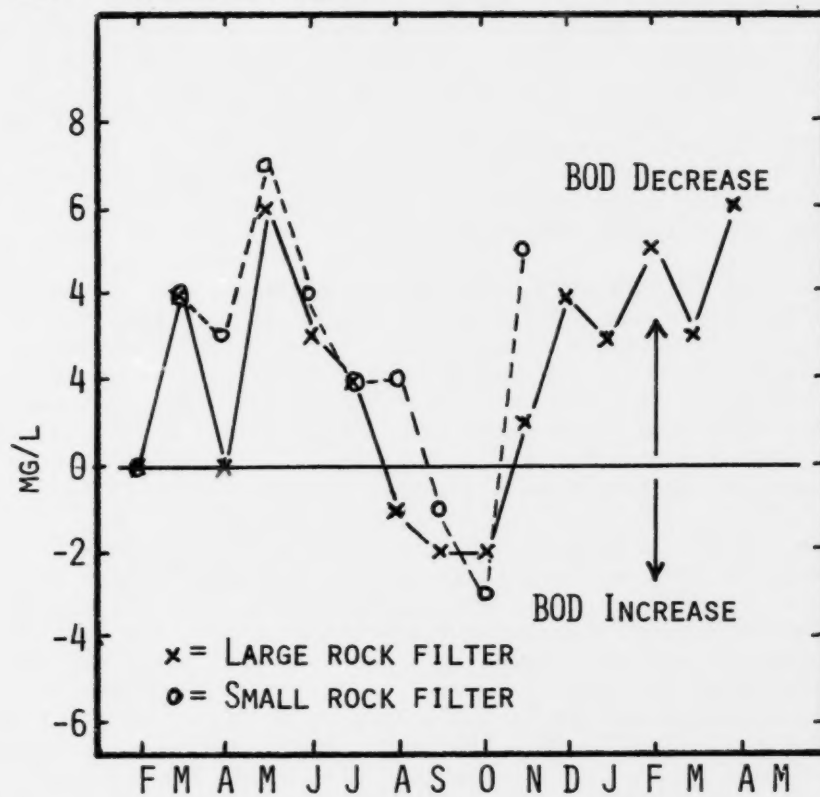


FIGURE 19. BOD REMOVED IN ROCK FILTERS.

filters removed both living microbial solids and inert suspended solids to about the same extent. The small quantities of change made precise interpretation all but impossible.

The change in dissolved oxygen during the study indicated 3.8 mg/l dissolved oxygen were utilized through the rock filters. The 3.8 mg/l dissolved oxygen use would have accounted for stabilization of 3.5 mg/l microbial mass by endogenous respiration. The remaining microbial mass removed by the rock filters resulted in the increased BOD₅ in the effluent, especially at the end of the summer as shown in Figure 19. The data indicated the importance of dissolved oxygen entering the rock filter since degradation of the microbial solids resulted in a definite oxygen demand within the rock filter. Without adequate oxygen anaerobic degradation will occur slowly.

Examination of effluent suspended solids and hydraulic loading rates, plotted in Figure 20, indicated that there was no significant variation in effluent suspended solids over the range of hydraulic flow in this study once the system was placed into operation. The variation in effluent quality appeared to be a random variation with the effluent from the small rock filter showing slightly better results than the large rock filter. The most significant fact was the large rock filter did not consistently produce an effluent under 30 mg/l suspended solids as originally desired to meet EPA Effluent Criteria.

Based on the results obtained from the Eudora rock filter pilot plant, the degree of effluent quality improvement was not adequate to meet the desired criteria. Suspended solids reductions increased as the suspended solids concentration applied increased but the effluent suspended solids still exceeded the desired limits. The microbial solids removed within the filter underwent degradation with a slight increase in effluent BOD₅. It would appear from this study that rock filters are not an economical method for adequately reducing suspended solids and BOD₅ in facultative lagoon effluents.

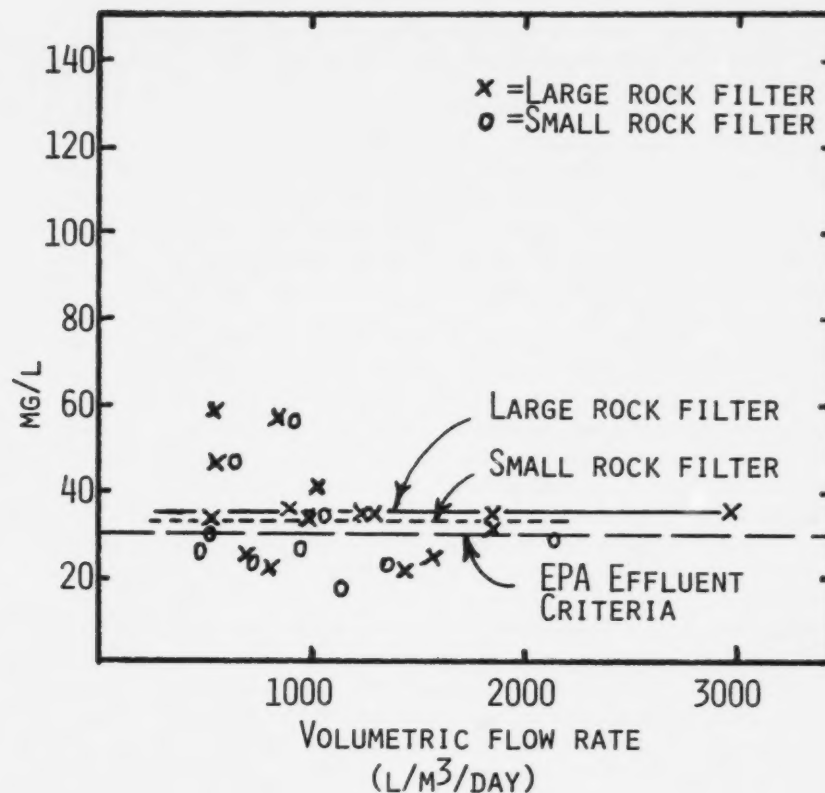


FIGURE 20. EFFLUENT SUSPENDED SOLIDS FROM ROCK FILTERS WITH VARYING VOLUMETRIC FLOW RATE.

REFERENCES

1. Middlebrooks, E. K., D. B. Porcella, R. A. Gearheart, G. R. Marshall, J. H. Reynolds and W. J. Grenney, "Techniques for Algae Removal from Wastewater Stabilization Ponds", Journal Water Pollution Control Federation, 46, 2676 (1974).
2. Martin, D. M., "Several Methods of Algae Removal in Municipal Oxidation Ponds", M.S. Thesis, University of Kansas, Lawrence, Kansas (1970).
3. Martin, J. L., and R. Weller, "Removal of Algae from Oxidation Pond Effluent by Upflow Rock Filtration", M.S. Thesis, University of Kansas, Lawrence, Kansas (1973).
4. Division of Environmental Health, "Policies Governing the Design of Sewerage Systems in Kansas", Kansas Department of Health, Topeka, Kansas (1970).

APPENDICES

APPENDIX A. WATER QUALITY, EFFLUENT FROM EUDORA LAGOON CELL 3

Date	Total SS mg/l	Volatile SS mg/l	Total COD mg/l	Soluble COD mg/l	Total BOD ₂ mg/l	Soluble BOD ₅ mg/l
06/01/73	53	-	108	60	-	-
06/02/73	90	78	128	39	-	-
06/03/73	73	60	112	40	23	-
06/04/73	70	60	138	73	32	26
06/05/73	68	60	103	25	23	26
06/06/73	68	60	119	35	38	5
06/07/73	60	58	127	-	-	-
06/08/73	65	60	110	35	33	-
06/09/73	88	72	-	-	-	-
06/10/73	108	-	-	-	-	-
06/11/73	183	152	130	40	25	4
06/12/73	105	95	176	72	29	5
06/13/73	90	68	217	98	29	4
06/14/73	78	70	123	54	21	5
06/15/73	75	70	155	49	19	9
06/16/73	53	40	132	72	40	28
06/17/73	25	-	108	72	33	20
06/18/73	35	35	126	54	46	25
06/20/73	65	58	-	-	40	8
06/21/73	45	38	90	40	36	19
06/22/73	55	38	132	24	-	-
06/23/73	35	35	124	72	18	6
06/24/73	42	40	123	49	18	6
06/25/73	49	38	95	64	16	11
06/26/73	42	39	124	79	17	8
06/27/73	76	67	-	-	-	-
06/28/73	58	56	98	53	14	2
06/29/73	59	58	113	53	17	3
06/30/73	38	-	86	49	20	10
07/01/73	-	-	-	-	-	-
07/02/73	-	-	-	-	-	-
07/03/73	68	63	98	60	22	8
07/04/73	60	60	135	49	27	6
07/05/73	60	-	132	56	28	8
07/06/73	50	50	114	68	28	7
07/06/73	43	-	133	30	25	7
07/08/73	-	-	-	-	-	-
07/09/73	-	-	104	72	43	-
07/10/73	-	-	92	84	18	9
07/11/73	36	28	-	-	15	1
07/12/73	-	-	-	-	-	8
07/13/73	26	23	90	46	13	7
07/30/73	-	-	-	-	-	-

APPENDIX A (continued)

Date	Total SS mg/l	Volatile SS mg/l	Total COD mg/l	Soluble COD mg/l	Total BOD ₅ mg/l	Soluble BOD ₅ mg/l
08/01/73	-	-	-	-	-	-
08/03/73	-	-	-	-	-	-
08/06/73	53	45	172	120	24	5
08/10/73	56	52	172	64	19	9
08/15/73	49	49	120	52	23	10
08/16/73	50	45	88	88	20	8
08/20/73	81	76	168	20	21	4
08/24/73	81	77	204	92	-	-
08/27/73	68	65	188	80	22	10
09/01/73	63	59	140	84	20	14
09/19/73	96	79	132	58	23	7
09/20/73	70	62	98	78	15	4
09/24/73	96	84	150	106	13	5
09/28/73	86	80	118	54	27	2
10/01/73	68	66	180	43	24	7
10/04/73	55	52	107	71	21	4
10/08/73	62	56	120	81	30	10
10/16/73	80	56	140	118	19	5
10/18/73	55	52	324	168	24	5
10/30/73	57	55	176	88	20	5
11/01/73	67	58	158	72	18	3
11/06/73	63	58	120	80	18	2
11/08/73	56	48	124	48	15	6
11/13/73	69	65	180	80	-	-
11/15/73	61	59	116	72	30	6
11/19/73	65	55	52	8	18	5
11/29/73	66	54	192	72	-	-
12/01/73	71	61	124	24	-	-
12/05/73	69	63	126	46	25	5
12/11/73	26	20	86	68	12	5
12/12/73	30	25	112	88	14	5
01/04/74	53	50	166	96	10	2
01/08/74	58	45	124	108	17	3
01/11/74	47	40	80	20	20	6
01/15/74	59	46	172	100	27	7
01/25/74	62	60	180	72	48	12
01/28/74	67	60	160	44	31	10
01/30/74	84	71	200	40	36	7
02/01/74	50	50	-	40	39	7
02/04/74	62	57	140	60	29	10
02/06/74	58	51	160	40	33	7
02/08/74	77	67	108	52	35	8
02/11/74	66	63	76	48	31	5
02/13/74	63	55	108	40	32	7
02/15/74	52	47	160	32	31	6
02/18/74	46	45	148	-	31	5
02/20/74	114	51	188	36	27	6
02/22/74	85	66	112	20	19	6
02/25/74	80	69	116	68	17	6
02/27/74	123	77	140	20	15	8
03/01/74	107	82	140	80	14	5
03/04/74	119	89	160	92	19	4
03/06/74	156	106	208	36	18	4
03/08/74	144	98	200	48	30	7
03/11/74	99	71	168	20	22	-
03/13/74	45	35	204	-	20	4
03/15/74	44	39	100	52	12	3
03/18/74	45	24	88	28	21	4
03/20/74	17	15	152	-	14	4
03/22/74	14	14	96	-	7	5
03/25/74	9	8	120	84	13	8
03/27/74	19	12	-	60	7	6
03/29/74	41	24	92	62	12	4

APPENDIX A (continued)

Date	Total SS mg/l	Volatile SS mg/l	Total COD mg/l	Soluble COD mg/l	Total BOD ₅ mg/l	Soluble BOD ₅ mg/l
04/01/74	26	13	68	64	9	6
04/03/74	45	22	64	-	12	6
04/05/74	46	27	80	52	13	2
04/08/74	25	18	68	60	13	8
04/10/74	42	20	100	-	18	5
04/12/74	41	19	-	-	-	-
04/15/74	64	54	116	60	30	7
04/17/74	64	46	104	60	22	5
04/19/74	64	43	140	88	28	5
04/22/74	43	36	104	-	23	4
04/24/74	53	42	100	-	16	2
04/26/74	50	38	100	72	26	2
04/29/74	53	49	140	-	27	2
05/01/74	38	35	-	-	14	2
05/03/74	54	46	120	68	17	2
05/06/74	-	-	-	-	-	-
05/08/74	70	58	125	52	23	4
05/10/74	57	47	119	50	25	3
05/13/74	89	41	109	50	21	4
05/15/74	61	51	107	44	24	6
05/17/74	51	40	-	56	11	3
05/20/74	34	29	71	62	8	3
05/22/74	62	50	139	48	16	4
05/23/74	47	37	102	53	15	4
05/28/74	46	33	68	56	9	4
05/29/74	44	33	81	57	10	3
05/31/74	48	39	80	32	11	3
06/03/74	54	42	89	53	14	4
06/05/74	46	32	82	35	10	2
06/07/74	46	37	100	43	9	5
06/10/74	42	31	82	56	13	3
06/12/74	46	37	92	44	9	3
06/14/74	67	50	114	56	15	2
06/17/74	-	-	108	52	12	2
06/19/74	53	41	92	46	11	5
06/21/74	52	41	94	35	13	3
06/24/74	56	45	109	53	18	2
06/26/74	59	52	94	37	15	2
06/28/74	50	27	90	31	18	3
07/01/74	52	38	83	48	16	2
07/03/74	59	47	83	46	13	2
07/05/74	45	32	92	52	10	2
07/08/74	42	37	77	36	12	3
07/10/74	49	34	91	51	14	4
07/12/74	-	-	91	51	16	3
07/15/74	56	40	84	49	15	3
07/17/74	59	47	106	58	15	4
07/19/74	60	40	93	40	9	2
07/22/74	60	49	119	45	14	6
07/24/74	61	45	111	59	17	6
07/26/74	64	51	111	38	14	5
07/29/74	68	57	111	46	14	4
07/31/74	69	56	136	65	14	4
08/02/74	64	46	119	44	15	4
08/05/74	84	65	131	52	21	6
08/07/74	43	66	129	56	18	5
08/09/74	80	72	131	52	17	3
08/12/74	85	69	179	53	18	3
08/14/74	77	65	128	53	22	4
08/16/74	56	53	130	51	21	5
08/19/74	71	67	137	52	15	4
08/21/74	61	54	129	48	11	6
08/23/74	61	58	139	40	15	3
08/26/74	65	56	136	64	18	2

APPENDIX A (continued)

Date	Total SS mg/l	Volatile SS mg/l	Total COD mg/l	Soluble COD mg/l	Total BOD ₅ mg/l	Soluble BOD ₅ mg/l
08/29/74	59	52	126	48	16	3
08/31/74	60	54	119	38	17	3
09/03/74	48	40	121	43	10	3
09/05/74	66	58	113	43	14	3
09/07/74	60	49	102	40	15	3
09/10/74	89	62	137	60	17	1
09/12/74	58	52	140	58	15	3
09/14/74	55	33	114	50	15	3
09/17/74	78	73	120	58	22	2
09/19/74	63	53	124	55	19	5
09/21/74	60	54	142	57	17	6
09/24/74	59	57	122	56	16	9
09/26/74	61	54	132	58	15	2
09/28/74	55	46	127	50	13	7
10/01/74	62	56	135	58	14	3
10/03/74	67	57	135	59	14	4
10/05/74	63	57	120	46	11	3
10/08/74	65	61	133	52	12	3
10/10/74	75	64	133	62	15	3
10/12/74	60	57	124	36	14	4
10/15/74	59	54	120	46	12	3
10/17/74	65	61	140	60	17	3
10/19/74	110	77	148	37	19	4
10/22/74	70	56	144	43	17	5
10/24/74	69	60	146	64	19	4
10/26/74	74	73	158	54	20	4
10/29/74	62	52	165	60	14	3
10/31/74	-	-	-	-	-	-
11/02/74	-	-	134	54	14	3
11/05/74	-	-	136	58	13	1
11/07/74	-	-	134	-	16	2
11/09/74	64	55	129	46	12	4
11/12/74	71	57	120	50	15	1
11/14/74	58	57	122	40	14	1
11/16/74	62	56	133	50	17	1
11/19/74	56	43	129	56	18	1
11/21/74	56	53	145	60	16	1
11/23/74	65	53	124	52	14	1
11/26/74	60	50	128	56	17	1
11/28/74	49	46	126	54	17	3
11/30/74	59	53	124	56	13	2
12/03/74	56	45	111	63	15	1
12/05/74	53	45	127	71	13	1
12/07/74	40	35	104	56	13	1
12/10/74	45	35	104	58	17	2
12/12/74	38	31	-	-	12	0
12/14/74	35	32	112	56	8	2
12/17/74	33	29	83	52	16	2
12/19/74	23	21	88	49	13	1
12/21/74	23	22	80	39	11	2
12/24/74	21	15	82	39	12	0
12/26/74	30	25	103	41	13	1
12/28/74	32	23	92	61	8	2
12/31/74	33	31	100	62	16	-
01/02/75	31	24	-	56	17	3
01/04/75	47	40	98	58	19	5
01/07/75	38	29	98	47	15	2
01/09/75	37	37	102	59	19	3
01/11/75	39	32	105	48	14	3
01/14/75	37	23	103	55	18	2
01/16/75	46	41	104	50	21	3
01/18/75	54	43	96	52	24	4
01/21/75	73	62	124	44	32	3
01/23/75	73	59	138	56	30	4

APPENDIX A (continued)

Date	Total SS mg/l	Volatile SS mg/l	Total COD mg/l	Soluble COD mg/l	Total BOD ₅ mg/l	Soluble BOD ₅ mg/l
01/24/75	57	46	130	55	22	2
01/27/75	55	41	119	53	32	5
01/29/75	56	44	119	56	27	6
01/31/75	57	48	117	60	25	6
02/03/75	57	46	119	54	26	7
02/05/75	56	47	118	58	30	7
02/07/75	58	53	127	60	24	5
02/10/75	62	48	124	63	20	5
02/12/75	66	58	157	66	16	8
02/14/75	41	36	114	57	27	11
02/17/75	56	54	119	60	32	5
02/19/75	83	61	141	56	48	4
02/21/75	73	55	129	52	39	6
02/24/75	74	62	153	67	41	6
02/26/75	86	65	153	58	60	7
02/28/75	81	64	143	66	44	7
03/03/75	61	50	124	50	27	4
03/05/75	62	56	124	48	35	2
03/07/75	66	49	133	56	30	3
03/11/75	75	62	120	46	28	3
03/13/75	66	61	134	52	29	3
03/15/75	70	55	133	54	31	3
03/17/75	79	49	153	58	40	6
03/19/75	113	94	143	52	33	1
03/21/75	58	-	163	62	41	6
03/24/75	69	66	153	63	44	5
03/27/75	-	-	-	-	-	-
03/29/75	-	-	-	-	-	-
03/31/75	62	53	118	56	30	2
04/02/75	94	53	122	51	32	6
04/04/75	113	46	120	65	26	3
04/07/75	15	5	147	96	25	4
04/09/75	12	12	163	83	38	5
04/11/75	68	39	136	54	31	5
04/14/75	51	33	128	72	31	4
04/16/75	38	34	-	71	28	4
04/18/75	44	36	137	76	26	5
04/21/75	63	41	123	64	28	2
04/23/75	43	35	116	62	29	6
04/25/75	47	45	126	62	30	9
04/28/75	49	48	129	48	22	<1
04/30/75	54	43	117	56	25	2
05/02/75	60	56	132	51	30	6
05/05/75	72	62	141	46	26	2
05/08/75	70	69	139	46	30	<1
05/10/75	65	62	143	54	23	2
05/14/75	79	73	156	44	-	-

APPENDIX A (continued)

Date	Ammonia mg/l as N	Total Phosphorus mg/l as P	Nitrate mg/l as N	Nitrite mg/l as N
06/01/73	-	-	-	-
06/02/73	-	-	-	-
06/03/73	-	-	-	-
06/04/73	4.00	3.04	.17	.008
06/05/73	1.22	3.64	.18	.006
06/06/73	1.27	5.10	.18	.0075
06/07/73	.696	4.90	.14	.010
06/08/73	.664	2.00	.12	.011
06/09/73	.544	1.65	.135	.008
06/10/73	.546	1.85	.300	.010
06/11/73	.620	-	-	.010
06/12/73	.664	2.04	.410	.012
06/13/73	.508	1.88	.300	.011
06/14/73	.308	1.45	.580	.010
06/15/73	1.10	.98	.220	.011
06/16/73	.96	2.10	.220	.015
06/17/73	1.96	3.05	.320	.020
06/18/73	5.6	4.90	.320	.002
06/20/73	3.04	3.60	.43	.0065
06/21/73	2.64	4.20	-	-
06/22/73	1.38	3.15	.19	.003
06/23/73	.46	1.80	.16	.0024
06/24/73	.98	1.10	.13	.0024
06/25/73	1.69	.90	.18	.0018
06/26/73	3.56	3.4	.16	.0012
06/27/73	1.35	1.7	.29	.0015
06/28/73	4.90	1.2	.22	.0015
06/29/73	1.33	.6	-	.0026
06/30/73	2.16	1.7	-	-
07/01/73	1.10	.8	-	-
07/02/73	1.18	1.0	-	-
07/03/73	.72	1.5	-	-
07/04/73	3.68	2.5	-	-
07/05/73	1.44	1.7	-	-
07/06/73	2.74	3.7	-	-
07/07/73	1.96	2.5	-	-
07/08/73	3.24	-	-	-
07/09/73	2.84	2.0	-	-
07/10/73	1.62	1.7	-	-
07/11/73	.74	.5	-	-
07/12/73	-	-	-	-
07/13/73	.40	.5	-	-
07/30/73	1.0	3.5	-	-
08/01/73	3.0	3.2	-	-
08/03/73	4.6	3.6	-	-
08/06/73	.4	4.4	-	-
08/10/73	2.0	3.2	-	-
08/15/73	4.5	3.4	-	-
08/16/73	3.0	3.6	-	-
08/20/73	.4	2.8	-	-
08/24/73	2.2	4.1	-	-
08/27/73	1.6	3.6	-	-
09/01/73	1.0	4.2	-	-
09/19/73	-	-	-	-
09/20/73	-	3.9	-	-
09/24/73	-	-	-	-
09/28/73	-	-	-	-
10/01/73	-	-	-	-
10/04/73	-	-	-	-
10/08/73	-	5.0	-	-
10/16/73	.92	5.0	-	-
10/18/73	.76	5.2	-	-
10/30/73	1.64	5.2	-	-

APPENDIX A (continued)

Date	Ammonia mg/l as N	Total Phosphorus mg/l as P	Nitrate mg/l as N	Nitrite mg/l as N
11/01/73	1.68	4.8		
11/06/73	1.3	3.4		
11/08/73	1.76	3.4		
11/13/73	1.52	6.0		
11/15/73	1.64	5.0		
11/19/73	1.64	5.2		
11/29/73	-	-		

Date	Water Temp °C	Dissolved Oxygen mg/l	pH	Ammonia mg/l as N	Total Phosphorus mg/l as P
12/05/73	5.0	-	-	-	-
12/11/73	7.0	-	7.5	-	-
12/12/73	6.0	-	7.5	-	-
01/04/74	3.0	-	7.8	-	-
01/08/74	2.0	-	-	-	-
01/11/74	2.0	-	7.6	-	-
01/15/74	2.0	-	7.8	-	-
01/25/74	4.5	-	-	10.1	7.3
01/28/74	4.5	-	6.8	10.0	8.3
01/30/74	-	-	8.0	10.0	8.3
02/01/74	4.0	-	7.3	11.5	7.0
02/04/74	3.5	-	7.5	13.0	7.5
02/06/74	3.5	-	7.4	15.0	7.6
02/08/74	1.0	-	7.7	16.0	8.6
02/11/74	4.5	-	7.4	12.5	8.2
02/13/74	7.0	-	7.5	11.5	8.3
02/15/74	-	-	7.4	12.0	9.4
02/18/74	7.0	-	7.9	18.5	8.0
02/20/74	7.0	-	7.8	21.0	8.2
02/22/74	6.5	-	7.4	17.0	8.0
02/25/74	5.0	-	7.4	18.5	8.0
02/27/74	7.5	-	8.2	16.0	8.0
03/01/74	7.5	-	8.4	16.0	8.0
03/04/74	11.5	-	7.4	12.0	8.4
03/06/74	12.5	-	8.5	10.5	7.8
03/08/74	15.0	-	8.1	9.5	9.5
03/11/74	11.0	-	7.4	12.0	5.7
03/13/74	10.0	-	8.0	12.0	4.8
03/15/74	11.0	-	8.2	10.5	4.7
03/18/74	10.5	-	7.7	10.5	5.4
03/20/74	8.0	-	7.7	10.0	5.7
03/22/74	7.0	-	7.6	14.5	5.7
03/25/74	6.0	-	7.6	12.0	6.0
03/27/74	10.0	-	7.6	14.5	6.3
03/29/74	13.0	-	7.7	12.0	6.8
04/01/74	15.0	5.7	7.4	10.0	7.0
04/03/74	15.5	9.3	7.9	11.5	7.4
04/05/74	11.0	8.7	7.2	11.0	10.3
04/08/74	11.5	9.8	7.6	12.0	7.2
04/10/74	12.5	12.5	8.1	10.0	6.7

APPENDIX A (continued)

Date	Water Temp °C	Dissolved Oxygen mg/l	pH	Ammonia mg/l as N	Total Phosphorus mg/l as P
04/12/74	14.0	14.0	7.7	9.5	6.5
04/15/74	11.9	16.4	-	9.0	6.5
04/17/74	14.5	14.2	8.5	8.0	5.9
04/19/74	17.5	16.0	8.4	8.0	4.7
04/22/74	19.0	-	-	6.9	4.7
04/24/74	19.0	12.4	8.6	6.9	4.7
04/26/74	19.0	10.0	-	5.0	3.8
04/29/74	20.0	13.0	8.2	8.0	3.4
05/01/74	20.0	10.5	8.6	4.4	3.1
05/03/74	19.0	13.9	8.6	2.3	3.5
05/06/74	-	-	-	-	-
05/08/74	20.0	12.4	9.3	1.1	2.9
05/10/74	18.9	7.4	8.8	0.4	2.6
05/13/74	21.1	4.5	8.3	0.7	2.6
05/15/74	20.3	7.5	8.6	0.7	2.5
05/17/74	23.0	4.1	-	0.7	2.4
05/20/74	25.0	4.6	8.6	0.2	2.1
05/22/74	25.5	1.0	8.5	0.6	2.8
05/23/74	24.0	6.3	8.3	0.23	2.0
05/28/74	22.5	4.5	8.6	0.16	2.8
05/29/74	25.0	5.5	8.9	<0.10	2.6
05/31/74	24.0	3.5	8.6	<0.15	3.0
06/03/74	23.9	6.2	8.4	<0.26	2.1
06/05/74	22.0	2.9	8.6	<0.26	2.5
06/07/74	21.5	4.3	8.5	<0.10	2.5
06/10/74	20.2	6.3	8.5	<0.10	2.5
06/12/74	22.0	7.8	8.8	0.21	2.3
06/14/74	25.0	6.5	8.5	0.12	2.2
06/17/74	17.8	4.0	8.4	0.20	2.4
06/19/74	25.6	2.2	8.7	0.18	2.4
06/21/74	27.0	3.3	8.3	0.16	2.4
06/24/74	24.0	7.5	8.8	0.13	2.4
06/26/74	25.1	3.6	8.7	<0.10	1.9
06/28/74	24.3	-	8.8	0.20	2.1
07/01/74	26.2	3.5	8.6	<0.10	1.9
07/03/74	26.9	4.8	8.7	<0.10	1.8
07/05/75	29.0	4.7	8.9	<0.10	1.6
07/08/74	29.9	5.5	8.8	<0.10	1.3
07/10/74	30.0	4.2	9.0	<0.10	1.6
07/12/74	32.0	7.0	8.9	<0.10	1.6
07/15/74	30.9	6.1	8.8	0.12	1.3
07/17/74	28.2	7.9	8.5	0.17	1.7
07/19/74	30.5	7.2	9.1	<0.10	1.5
07/22/74	31.4	5.6	9.1	<0.10	1.4
07/24/74	29.2	4.0	8.7	<0.10	1.7
07/26/74	28.4	2.6	8.7	0.14	1.8
07/29/74	28.9	6.5	8.6	0.10	1.9
07/31/74	27.9	5.3	8.8	<0.10	1.8
08/02/74	26.2	5.3	8.8	<0.10	1.8
08/05/74	25.4	7.0	8.8	0.18	1.8
08/07/74	22.3	5.4	8.8	0.16	1.95
08/09/74	25.2	6.1	8.8	0.27	1.9
08/12/74	27.0	8.1	9.1	0.30	1.7
08/14/74	26.2	7.5	8.9	<0.1	1.8
08/16/74	-	-	8.7	-	-
08/19/74	-	-	8.9	0.27	1.9
08/21/74	26.1	6.9	8.9	0.15	1.1
08/23/74	25.5	6.6	8.9	1.56	-
08/26/74	27.1	2.2	8.8	2.20	2.25
08/29/74	23.4	6.2	8.6	0.23	2.23
08/31/74	22.7	5.5	8.6	0.25	1.9
09/03/74	22.5	5.6	8.5	3.90	1.6
09/05/74	19.2	11.3	9.4	1.75	1.8
09/07/74	18.5	11.0	8.9	2.50	1.9

APPENDIX A (continued)

Date	Water Temp °C	Dissolved Oxygen mg/l	pH	Ammonia mg/l as N	Total Phosphorus mg/l as P
09/10/74	22.9	9.8	9.2	0.13	1.8
09/12/74	22.4	6.6	8.5	<0.10	2.1
09/14/74	18.4	3.0	8.5	1.15	2.1
09/17/74	20.3	6.5	8.4	0.52	3.6
09/19/74	20.3	-	9.1	0.57	2.3
09/21/74	19.7	4.0	8.9	0.34	2.3
09/24/74	18.1	8.0	8.9	0.20	2.3
09/26/74	18.1	8.3	9.2	<0.10	2.6
09/28/74	18.0	7.0	8.4	0.15	3.7
10/01/74	16.8	9.3	8.9	0.16	2.2
10/03/74	15.0	9.3	8.9	0.19	2.2
10/05/74	16.4	6.7	8.8	0.25	3.1
10/08/74	14.9	11.0	8.9	0.60	3.3
10/10/74	16.0	11.5	8.9	1.10	3.5
10/12/74	17.0	6.7	8.7	0.90	3.6
10/15/74	13.8	6.6	8.7	0.92	3.8
10/17/74	15.1	8.5	8.6	-	3.9
10/19/74	15.0	10.0	8.8	1.14	3.9
10/22/74	13.2	8.4	8.8	0.85	4.2
10/24/74	15.1	7.6	7.7	1.14	-
10/26/74	16.0	11.0	8.7	1.24	-
10/29/74	16.2	6.0	8.5	1.30	4.2
10/31/74	-	-	-	-	-
11/02/74	15.8	5.8	8.3	-	-
11/05/74	10.7	6.7	8.4	-	-
11/07/74	9.7	6.0	7.5	-	-
11/09/74	9.4	9.2	8.2	.58	2.2
11/12/74	8.1	8.1	8.0	-	2.2
11/14/74	7.3	10.5	8.0	-	2.4
11/16/74	7.0	13.5	7.9	-	2.1
11/19/74	8.9	8.2	8.0	.14	.6
11/21/74	9.2	12.0	7.5	.06	2.6
11/23/74	11.3	11.5	7.9	0.18	4.2
11/26/74	6.1	9.3	8.3	0.15	4.9
11/28/74	5.8	-	7.9	0.12	2.8
11/30/74	3.2	10.5	8.2	0.45	2.8
12/03/74	3.0	11.8	8.6	0.24	3.2
12/05/74	5.1	17.2	8.5	0.21	2.5
12/07/74	6.0	15.4	8.2	0.35	3.3
12/10/74	3.8	13.4	8.5	0.37	3.0
12/12/74	3.8	12.6	8.4	0.51	3.0
12/14/74	4.2	13.4	8.3	0.45	4.0
12/17/74	-	-	7.9	0.45	3.0
12/19/74	2.8	17.5	8.6	0.40	3.1
12/21/74	4.0	16.3	8.6	0.35	3.0
12/24/74	3.2	16.4	8.5	-	3.2
12/26/74	2.8	19.9	8.5	0.62	3.6
12/28/74	3.9	16.2	8.6	0.46	3.2
12/31/74	3.9	18.5	8.7	0.86	2.8
01/02/75	3.3	19.0	8.5	1.00	3.2
01/04/75	4.0	19.5	8.5	1.20	3.4
01/07/75	4.0	17.0	8.4	2.50	3.8
01/09/75	4.0	17.0	8.5	3.30	3.0
01/11/75	1.8	19.8	8.3	2.40	3.3
01/14/75	1.9	20.0	8.8	2.35	5.3
01/16/75	2.6	21.6	8.8	2.15	5.8
01/18/75	4.0	20.0	8.7	1.95	4.2
01/21/75	5.0	19.2	8.7	2.25	3.2
01/23/75	3.1	25.0	8.7	2.10	3.7
01/24/75	2.4	25.0	8.9	2.80	4.4
01/27/75	3.0	18.5	8.3	3.85	3.3
01/29/75	2.5	17.5	8.4	3.85	3.4
01/31/75	1.5	15.0	8.6	3.02	3.3
02/03/75	1.5	13.5	7.9	2.85	3.7
02/05/75	0.5	10.5	8.4	3.05	4.2

APPENDIX A (continued)

Date	Water Temp °C	Dissolved Oxygen mg/l	pH	Ammonia mg/l as N	Total Phosphorus mg/l as P
02/07/75	1.0	16.5	8.6	2.75	3.8
02/10/75	3.0	24.5	8.9	3.00	3.7
02/12/75	2.0	17.0	8.7	2.85	3.5
02/14/75	2.0	17.0	8.4	3.64	4.0
02/17/75	-	16.0	8.4	3.64	3.8
02/19/75	4.0	20.0	9.3	2.63	2.8
02/21/75	4.0	9.4	9.3	1.84	1.9
02/24/75	3.0	6.4	8.6	2.16	1.4
02/26/75	-	20.0	8.9	2.55	2.0
02/28/75	7.0	14.0	9.0	2.45	1.6
03/03/75	4.0	17.4	8.4	5.20	-
03/05/75	6.0	20.0	8.5	4.05	4.2
03/07/75	6.5	14.5	8.0	3.70	3.6
03/11/75	3.8	13.5	8.9	3.08	3.0
03/13/75	4.2	16.8	9.0	2.80	3.0
03/15/75	6.2	19.7	9.0	2.06	2.2
03/17/75	7.0	20.5	8.8	1.87	1.8
03/19/75	10.0	19.0	9.2	1.64	1.8
03/21/75	13.0	21.5	9.1	1.25	1.7
03/24/75	12.0	12.5	9.0	0.61	1.7
03/27/75	-	-	-	-	-
03/29/75	-	-	-	-	-
03/31/75	7.0	12.5	9.1	0.82	3.1
04/02/75	7.0	13.5	8.6	0.80	2.0
04/04/75	7.0	14.5	9.0	0.73	1.0
04/07/75	11.0	11.0	9.1	0.73	1.6
04/09/75	10.0	8.5	8.9	0.91	2.0
04/11/75	10.0	8.5	8.9	0.80	1.8
04/14/75	11.0	7.0	9.1	1.08	1.9
04/16/75	13.0	11.0	9.0	1.27	1.9
04/18/75	18.0	10.0	9.0	1.05	1.8
04/21/75	16.0	10.5	9.1	1.00	1.3
04/23/75	18.0	6.0	8.8	1.15	1.3
04/25/75	20.0	11.5	8.9	0.95	1.3
04/28/75	21.0	3.5	9.0	1.34	1.3
04/30/75	21.0	12.5	8.9	1.05	1.0
05/02/75	-	-	-	1.15	1.2
05/05/75	21.0	15.0	-	0.41	1.1
05/08/75	23.0	11.0	9.3	0.48	0.7
05/10/75	24.0	13.0	9.2	0.02	0.7
05/14/75	22.0	-	9.0	0.01	1.0

APPENDIX B. WATER QUALITY, INFLUENT TO ROCK FILTERS

Date	Total SS mg/l	Volatile SS mg/l	Total COD mg/l	Soluble COD mg/l	Total BOD ₅ mg/l	Soluble BOD ₅ mg/l
01/25/74	54	52	200	88	42	11
01/28/74	70	59	112	40	34	10
01/30/74	66	52	-	-	33	7
02/01/74	62	55	160	-	37	7
02/04/74	67	63	140	56	33	8
02/06/74	50	47	172	72	33	7
02/08/74	63	59	152	56	33	6
02/11/74	62	57	112	72	28	5
02/13/74	67	57	-	32	28	6
02/15/74	45	38	132	40	29	6
02/18/74	48	46	208	40	29	5
02/20/74	59	51	148	76	24	6
02/22/74	92	55	160	72	19	5
02/25/74	76	62	-	60	15	5
02/27/74	117	87	148	28	21	5
03/01/74	91	79	188	56	24	8
03/04/74	118	87	204	76	21	4
03/06/74	157	109	208	32	21	3
03/08/74	128	84	212	52	34	6
03/11/74	129	79	220	64	29	4
03/13/74	41	33	102	52	13	5
03/15/74	39	33	88	40	15	4
03/18/74	33	19	76	40	14	6
03/20/74	17	13	80	32	9	6
03/22/74	11	9	86	76	7	4
03/25/74	12	11	100	80	7	7
03/27/74	31	21	-	-	9	6
03/29/74	13	7	108	84	12	7
04/01/74	20	13	-	56	11	6
04/03/74	28	17	76	64	14	5
04/05/74	36	22	80	52	8	8
04/08/74	24	15	-	56	13	7
04/10/74	31	24	108	-	17	4
04/12/74	37	32	-	-	-	-
04/15/74	44	33	112	68	17	4
04/17/74	75	46	-	60	26	5
04/19/74	61	43	148	84	31	7
04/22/74	46	42	-	-	19	4
04/24/74	41	31	108	64	16	1
04/26/74	47	36	108	72	28	5
04/29/74	56	51	160	-	29	3
05/01/74	30	30	132	76	19	2
05/03/74	44	38	120	64	21	2
05/06/74	56	49	-	-	32	5
05/08/74	72	55	141	48	27	3
05/10/74	62	48	119	56	22	4
05/13/74	56	42	121	44	25	3
05/15/74	58	48	93	42	21	5
05/17/74	52	42	93	48	20	5
05/20/74	33	30	81	44	11	4
05/22/74	40	29	93	-	13	3
05/23/74	44	37	82	53	19	3
05/28/74	51	37	80	44	13	3
05/29/74	42	33	73	36	9	2
05/31/74	34	23	72	36	9	4
06/03/74	44	31	77	48	9	2
06/05/74	39	29	69	51	10	3
06/07/74	41	35	84	43	9	1
06/10/74	40	33	72	50	17	6
06/12/74	38	33	82	40	9	2
06/14/74	58	44	96	48	14	2
06/17/74	-	-	-	-	-	-
06/19/74	50	40	90	42	9	2
06/21/74	46	32	90	39	10	4

APPENDIX B (continued)

Date	Total SS mg/l	Volatile SS mg/l	Total COD mg/l	Soluble COD mg/l	Total BOD ₅ mg/l	Soluble BOD ₅ mg/l
06/24/74	48	38	95	47	13	2
06/26/74	45	41	92	39	13	3
06/28/74	37	23	75	27	15	2
07/01/74	44	31	95	44	11	3
07/03/74	40	31	107	48	10	2
07/05/74	34	24	100	52	8	2
07/08/74	33	29	89	44	7	4
07/10/74	46	34	101	47	7	3
07/12/74	53	34	91	47	12	3
07/15/74	-	-	-	-	-	-
07/17/74	50	33	96	54	12	5
07/19/74	47	28	85	48	10	3
07/22/74	48	38	98	45	12	5
07/24/74	49	39	141	63	15	6
07/26/74	54	43	108	38	13	6
07/29/74	57	49	100	54	12	4
07/31/74	64	53	144	69	15	4
08/02/74	58	43	115	64	14	3
08/05/74	70	58	127	60	17	6
08/07/74	72	58	117	56	17	6
08/09/74	60	54	128	52	11	3
08/12/74	69	53	120	53	19	4
08/14/74	73	59	118	49	20	5
08/16/74	59	52	154	59	18	4
08/19/74	55	49	120	66	13	4
08/21/74	54	48	124	52	10	6
08/23/74	60	42	123	44	12	3
08/26/74	61	48	140	60	15	3
08/29/74	47	45	114	52	17	4
08/31/74	42	40	99	41	19	7
09/03/74	-	-	-	-	-	-
09/05/74	61	54	111	40	14	4
09/07/74	58	53	102	32	10	4
09/10/74	68	58	137	33	17	3
09/12/74	56	45	128	50	17	4
09/14/74	53	33	114	46	15	4
09/17/74	-	-	-	-	-	-
09/19/74	63	55	115	55	18	4
09/21/74	55	51	132	55	16	5
09/24/74	56	52	114	56	14	3
09/26/74	53	51	126	60	15	3
09/28/74	54	42	127	46	13	3
10/01/74	53	52	121	58	12	3
10/03/74	54	47	128	59	14	4
10/05/74	51	48	103	42	8	3
10/08/74	60	57	131	44	11	3
10/10/74	71	56	123	52	14	4
10/12/74	58	51	124	40	13	4
10/15/74	58	52	120	46	11	2
10/17/74	60	58	117	55	17	4
10/19/74	124	108	156	41	24	4
10/22/74	63	52	132	51	16	4
10/24/74	65	53	130	54	18	5
10/26/74	64	64	147	46	22	3
10/29/74	65	51	159	58	22	7
10/31/74	-	-	-	-	-	-
11/02/74						
11/05/74						
11/07/74						
11/09/74	56	51	121	42	13	1
11/12/74	63	46	114	42	12	1
11/14/74	56	54	110	54	13	1
11/16/74	67	53	122	46	17	1
11/19/74	50	44	122	46	16	1
11/21/74	54	48	131	48	15	1

NOT IN OPERATION

APPENDIX B (continued)

Date	Total SS mg/l	Volatile SS mg/l	Total COD mg/l	Soluble COD mg/l	Total BOD ₅ mg/l	Soluble BOD ₅ mg/l
11/23/74	58	47	120	56	15	1
11/26/74	50	45	118	52	15	1
11/28/74	43	41	116	50	16	2
11/30/74	55	50	116	48	14	3
12/03/74	57	44	113	56	15	1
12/05/74	50	46	115	60	-	-
12/07/74	41	36	98	50	13	4
12/10/74	38	32	96	50	16	2
12/12/74	33	27	-	-	14	1
12/14/74	31	28	106	52	13	2
12/17/74	28	24	76	48	13	1
12/19/74	23	21	76	43	12	1
12/21/74	24	24	72	41	11	1
12/24/74	22	19	80	39	12	2
12/26/74	28	27	101	43	13	2
12/28/74	31	19	88	59	8	2
12/31/74	39	29	98	48	15	0
01/02/75	34	27	-	54	13	3
01/04/75	35	30	94	60	19	3
01/07/75	39	29	106	49	18	3
01/09/75	41	36	122	49	20	3
01/11/75	35	29	95	48	15	2
01/14/75	35	27	101	47	17	2
01/16/75	46	39	98	50	19	3
01/18/75	47	40	108	52	26	4
01/21/75	54	43	118	54	24	2
01/23/75	62	49	124	54	28	4
01/24/75	50	40	104	49	26	5
01/27/75	51	47	117	53	35	4
01/29/75	54	45	116	54	26	5
01/31/75	53	46	109	56	24	6
02/03/75	51	42	117	56	27	5
02/05/75	53	44	116	54	28	7
02/07/75	60	54	123	56	24	6
02/10/75	50	43	120	57	24	6
02/12/75	37	34	120	50	18	5
02/14/75	43	40	114	57	22	6
02/17/75	42	40	105	54	18	3
02/19/75	48	37	105	52	25	6
02/21/75	44	39	109	56	22	6
02/24/75	47	43	113	55	26	5
02/26/75	81	70	193	62	62	7
02/28/75	53	47	126	52	37	8
03/03/75	48	43	116	48	28	4
03/05/75	51	48	128	50	36	3
03/07/75	57	46	129	52	28	3
03/11/75	62	54	137	46	26	5
03/13/75	56	54	126	52	29	5
03/15/75	57	47	129	44	34	5
03/17/75	60	36	143	56	36	8
03/19/75	75	63	121	56	35	8
03/21/75	46	-	155	40	40	5
03/24/75	55	55	143	52	33	6
03/27/75	60	40	121	40	30	7
03/29/75	43	32	107	50	21	11
03/31/75	55	51	116	58	33	6
04/02/75	71	42	112	55	31	4
04/04/75	112	63	138	61	32	5
04/07/75	27	24	163	99	29	5
04/09/75	22	22	161	66	39	7
04/11/75	78	56	174	60	32	5
04/14/75	45	28	128	68	30	7
04/16/75	37	36	-	66	30	7
04/18/75	54	48	149	66	38	5

APPENDIX B (continued)

Date	Total SS mg/l	Volatile SS mg/l	Total COD mg/l	Soluble COD mg/l	Total BOD ₅ mg/l	Soluble BOD ₅ mg/l
04/21/75	48	37	119	58	27	6
04/23/75	39	32	128	62	28	8
04/25/75	39	37	114	56	27	7
04/28/75	31	31	104	48	19	3
04/30/75	44	40	113	56	25	4
05/02/75	45	45	119	45	26	9
05/05/75	52	45	127	44	25	3
05/08/75	42	42	113	50	24	<1
05/10/75	43	43	121	56	23	5
05/14/75	73	65	156	64	-	-
05/16/75	-	-	-	-	-	-

Date	Water Temp °C	Dissolved Oxygen mg/l	pH	Ammonia mg/l as N	Total Phosphorus mg/l as P
01/25/74	4.5	-	-	10.0	7.5
01/28/74	4.5	-	6.8	10.0	7.8
01/30/74	-	-	8.0	10.1	8.0
02/01/74	4.0	-	7.6	12.5	7.3
02/04/74	3.5	-	7.7	13.0	7.3
02/06/74	4.0	-	7.4	16.5	7.4
02/08/74	1.0	-	7.7	16.5	7.9
02/11/74	4.5	-	7.4	13.0	8.2
02/13/74	5.0	-	7.5	12.5	8.1
02/15/74	-	-	7.7	12.5	8.4
02/18/74	6.5	-	7.9	20.0	8.1
02/20/74	6.5	-	7.8	18.5	8.0
02/22/74	7.0	-	7.4	17.0	7.8
02/25/74	4.5	-	7.3	17.0	7.7
02/27/74	7.5	-	8.1	17.0	8.0
03/01/74	5.0	-	7.9	18.0	8.6
03/04/74	11.5	-	7.5	10.5	8.0
03/06/74	12.0	-	8.1	10.5	8.2
03/08/74	17.0	-	8.1	9.0	8.2
03/11/74	11.5	-	7.4	10.5	3.1
03/13/74	10.0	-	7.9	12.0	5.0
03/15/74	10.0	-	8.0	10.0	4.9
03/18/74	11.0	-	7.5	10.0	5.4
03/20/74	8.0	-	7.7	10.0	5.7
03/22/74	7.0	-	7.4	14.0	6.0
03/25/74	6.5	-	7.5	11.0	6.5
03/27/74	9.0	-	7.5	10.0	6.7
03/29/74	12.0	-	7.7	11.0	6.6
04/01/74	15.0	4.0	7.6	9.5	7.2
04/03/74	14.0	5.5	7.6	13.0	7.2
04/05/74	11.0	6.5	7.3	10.5	7.6
04/08/74	10.4	7.0	7.5	11.0	7.4
04/10/74	12.5	7.7	7.9	8.5	6.8
04/12/74	14.0	8.2	7.6	8.5	6.7
04/15/74	12.5	6.8	-	8.0	6.1
04/17/74	11.6	8.9	8.5	6.9	5.8
04/19/74	16.0	6.5	8.4	6.9	4.8
04/22/74	17.0	1.5	-	6.5	4.7
04/24/74	16.5	1.2	8.4	6.4	4.3

APPENDIX B (continued)

Date	Water Temp °C	Dissolved Oxygen mg/l	pH	Ammonia mg/l as N	Total Phosphorus mg/l as P
04/26/74	18.0	1.0	-	4.7	3.8
04/29/74	19.0	3.6	8.1	6.0	3.4
05/01/74	19.0	4.2	8.5	3.5	3.3
05/03/74	19.0	3.8	8.5	1.9	3.4
05/06/74	18.1	6.3	8.1	1.2	3.1
05/08/74	19.0	4.1	9.2	1.1	2.8
05/10/74	19.0	3.0	8.7	0.5	2.6
05/13/74	20.1	0.6	8.4	1.1	2.9
05/15/74	20.0	0.7	8.5	0.8	2.8
05/17/74	-	0.5	-	1.1	3.2
05/20/74	24.8	0.7	8.1	0.9	2.2
05/22/74	25.0	3.6	8.5	0.6	2.5
05/23/74	25.0	5.1	8.4	0.33	2.4
05/28/74	22.0	5.0	8.5	0.15	2.6
05/29/74	25.0	5.1	8.8	<0.10	2.8
05/31/74	24.0	3.5	8.5	<0.15	2.6
06/03/74	24.1	3.6	8.3	<0.26	2.1
06/05/74	22.5	2.4	8.5	<0.26	2.5
06/07/74	22.0	4.1	8.4	<0.10	2.4
06/10/74	19.8	5.1	8.3	0.80	2.6
06/12/74	22.0	4.9	8.7	0.15	2.5
06/14/74	24.2	4.0	8.4	0.15	2.3
06/17/74	-	-	-	-	-
06/19/74	25.7	3.8	8.7	0.12	2.2
06/21/74	26.5	2.8	8.3	0.13	2.5
06/24/74	25.0	3.9	8.8	<0.10	2.1
06/26/74	25.0	2.0	-	<0.10	2.0
06/28/74	25.1	1.8	8.8	0.11	2.2
07/01/74	26.1	0.5	8.4	<0.10	1.9
07/03/74	26.0	0.3	8.5	0.30	1.9
07/05/74	28.0	0.2	8.7	0.24	1.7
07/08/74	28.3	0.3	8.8	0.16	1.4
07/10/74	29.0	0.5	8.6	0.24	1.7
07/12/74	28.1	1.6	8.8	<0.10	1.7
07/15/74	-	-	-	-	-
07/17/74	28.0	0.6	8.5	0.36	1.6
07/19/74	29.3	0.5	8.6	<0.10	1.4
07/22/74	30.6	0.6	8.8	0.26	1.3
07/24/74	28.9	0.5	8.5	0.15	1.8
07/26/74	27.8	0.8	8.4	0.26	1.8
07/29/74	28.2	0.5	8.5	0.16	1.8
07/31/75	27.8	0.8	8.6	0.30	1.8
08/02/74	26.0	0.5	8.6	<0.10	1.8
08/05/74	25.4	0.8	5.5	0.22	1.9
08/07/74	22.9	0.8	8.5	0.27	2.0
08/09/74	24.9	0.6	8.7	0.21	1.9
08/12/74	26.4	0.6	8.8	0.22	1.8
08/14/74	25.9	0.5	8.6	<0.10	1.9
08/16/74	26.0	1.0	8.5	-	-
08/19/74	-	-	8.7	0.26	2.0
08/21/74	26.1	0.2	8.7	0.23	1.5
08/23/74	25.3	0.2	8.6	0.39	-
08/26/74	26.8	0.2	8.6	1.90	2.0
08/29/74	23.4	0.7	8.2	0.95	2.1
08/31/74	22.2	0.5	8.3	2.10	1.9
09/03/74	-	-	-	-	-
09/05/74	18.0	9.2	9.5	1.85	1.6
09/07/74	18.8	17.8	8.7	1.85	1.9
09/10/74	22.9	5.1	9.5	0.38	1.9
09/12/74	22.8	3.6	8.3	0.14	1.8
09/14/74	18.4	3.7	8.4	1.05	2.1
09/17/74	-	-	-	-	-
09/19/74	20.7	4.1	8.8	0.57	2.1
09/21/74	19.9	3.9	8.9	0.44	2.3
09/24/74	18.0	6.3	8.6	0.20	2.6

APPENDIX B (continued)

Date	Water Temp °C	Dissolved Oxygen mg/l	pH	Ammonia mg/l as N	Total Phosphorus mg/l as P
09/26/74	17.3	6.3	8.7	<0.10	2.6
09/28/74	19.0	5.8	8.4	0.10	2.8
10/01/74	17.2	6.2	8.7	0.19	2.3
10/03/74	14.9	6.7	9.2	0.19	2.2
10/05/74	17.0	1.5	8.6	1.00	3.5
10/08/74	14.8	6.6	8.7	0.75	3.2
10/10/74	16.0	6.3	8.8	0.93	3.5
10/12/74	17.8	4.1	8.7	0.91	3.6
10/15/74	14.2	6.0	8.6	1.27	3.5
10/17/74	14.8	5.7	8.7	1.70	3.5
10/19/74	15.2	6.3	8.7	1.05	4.2
10/22/74	13.5	7.0	8.7	1.66	4.2
10/24/74	14.8	5.6	8.1	1.76	-
10/26/74	17.1	5.4	8.4	-	-
10/29/74	16.5	1.1	8.3	2.70	-
10/31/74	-	-	-	-	-
11/02/74					
11/05/74					
11/07/74					
11/09/74	9.2	9.0	8.2	0.45	2.1
11/12/74	9.2	6.8	7.8	-	2.4
11/14/74	7.8	9.4	7.9	0.22	2.4
11/16/74	8.0	7.9	7.8	0.19	2.6
11/19/74	9.4	7.3	8.0	0.18	1.0
11/21/74	8.8	8.4	7.9	0.19	2.4
11/23/74	10.9	7.9	7.8	0.36	5.2
11/26/74	7.8	8.7	8.2	0.10	3.7
11/28/74	7.2	10.7	7.8	0.13	2.8
11/30/74	2.5	11.1	8.3	0.22	2.8
12/03/74	4.7	10.6	8.5	0.28	2.6
12/05/74	5.1	12.2	8.6	0.09	2.4
12/07/74	6.0	14.7	7.4	0.30	3.1
12/10/74	4.8	11.4	8.4	0.28	2.8
12/12/74	3.9	11.2	8.3	0.34	3.0
12/14/74	4.2	10.6	8.3	0.38	3.3
12/17/74	3.2	11.6	8.0	0.44	3.0
12/19/74	3.9	11.2	8.5	0.46	3.5
12/21/74	4.2	11.8	8.5	0.30	3.1
12/24/74	3.0	12.0	8.4	-	3.6
12/26/74	2.8	15.0	8.5	0.62	3.2
12/28/74	3.7	13.1	8.5	0.50	3.7
12/31/74	3.9	12.4	8.5	0.58	3.7
01/02/75	3.3	14.2	7.9	1.20	3.6
01/04/75	4.0	16.5	8.7	0.84	3.6
01/07/75	4.0	15.5	8.6	1.15	3.2
01/09/75	3.9	16.8	8.7	1.10	3.7
01/11/75	2.0	17.0	8.2	2.40	5.0
01/14/75	2.0	14.7	8.8	2.35	3.3
01/16/75	2.6	16.5	8.8	2.15	5.9
01/18/75	4.0	14.8	8.7	2.15	4.5
01/21/75	3.3	17.0	8.6	2.05	4.2
01/23/75	2.9	18.8	8.8	1.87	5.2
01/24/75	2.5	16.2	8.8	2.30	4.7
01/27/75	3.0	13.5	8.5	2.70	3.4
01/29/75	3.0	12.5	8.3	2.48	4.4
01/31/75	2.0	11.5	8.2	2.36	3.4
02/03/75	2.0	9.0	8.4	2.63	3.6
02/05/75	1.0	8.0	8.2	2.95	3.4
02/07/75	2.0	9.5	8.5	2.75	3.8
02/10/75	3.0	11.5	8.8	2.75	3.9
02/12/75	2.0	10.5	8.5	3.05	3.8
02/14/75	2.0	9.5	8.3	3.23	3.8
02/17/75	-	11.0	8.1	3.95	3.9
02/19/75	4.0	11.9	8.6	3.90	2.8

APPENDIX B (continued)

Date	Water Temp °C	Dissolved Oxygen mg/l	pH	Ammonia mg/l as N	Total Phosphorus mg/l as P
02/21/75	4.0	12.0	8.6	3.71	7.0
02/24/75	3.5	11.0	8.4	4.25	6.5
02/26/75	-	14.0	8.2	4.20	2.9
02/28/75	6.0	12.8	8.3	3.50	4.4
03/03/75	4.5	4.0	8.0	3.40	4.0
03/05/75	6.0	5.0	8.2	2.80	4.3
03/07/75	6.5	2.5	7.9	2.95	3.6
03/11/75	4.1	-	8.6	2.24	3.2
03/11/75	4.3	6.8	8.7	1.96	2.6
03/15/75	4.9	6.4	8.8	1.56	2.8
03/17/75	7.0	7.0	8.6	1.49	2.3
03/19/75	8.0	7.0	8.7	1.60	2.5
03/21/75	11.0	3.0	8.9	0.71	2.2
03/24/75	11.0	1.0	8.7	0.95	1.4
03/27/75	7.9	3.0	8.8	0.65	1.1
03/29/75	7.0	3.0	8.8	1.04	2.1
03/31/75	7.0	9.5	8.7	0.50	3.1
04/02/75	7.0	13.5	8.6	0.65	0.9
04/04/75	7.0	7.5	9.0	0.76	1.3
04/07/75	10.0	4.5	9.0	0.42	2.0
04/09/75	9.0	2.5	8.7	0.85	2.0
04/11/75	10.0	5.0	8.4	0.68	1.8
04/14/75	11.0	2.5	8.9	0.73	1.8
04/16/75	13.0	2.0	8.8	0.65	1.8
04/18/75	16.0	1.5	8.8	0.91	1.8
04/21/75	15.0	3.5	9.0	0.91	1.4
04/23/75	18.0	-	8.7	1.05	1.4
04/25/75	18.0	-	8.6	1.22	1.4
04/28/75	19.0	2.5	8.9	1.54	1.6
04/30/75	20.0	-	8.7	1.28	1.0
05/02/75	-	-	-	1.20	1.0
05/05/75	20.0	0	-	0.98	1.1
05/08/75	21.0	0	9.1	0.80	1.1
05/10/75	22.0	1	8.9	0.72	1.0
05/14/75	19.2	-	8.35	1.50	1.8
05/16/75	22.0	1.5	9.4	-	-

APPENDIX C. WATER QUALITY, EFFLUENT FROM LARGE ROCK FILTER

Date	Total SS mg/l	Volatile SS mg/l	Total COD mg/l	Soluble COD mg/l	Total BOD ₅ mg/l	Soluble BOD ₅ mg/l
01/25/74	44	43	136	88	26	10
01/28/74	53	40	156	20	25	9
01/30/74	53	39	160	20	25	6
02/01/74	45	41	-	-	29	8
02/04/74	50	47	180	60	29	6
02/06/74	46	38	140	24	24	6
02/08/74	41	29	80	36	24	5
02/11/74	47	44	120	40	20	6
02/13/74	47	39	88	72	21	6
02/15/74	44	41	128	28	22	5
02/18/74	50	43	168	48	22	5
02/20/74	71	62	132	56	19	6
02/22/74	72	61	108	56	13	5
02/25/74	69	60	148	64	14	5
02/27/74	84	70	156	36	14	11
03/01/74	124	94	176	44	20	6
03/04/74	119	83	172	60	17	5
03/06/74	93	74	140	40	10	4
03/08/74	111	67	136	40	29	5
03/11/74	69	47	128	52	14	-
03/13/74	70	42	100	32	11	5
03/15/74	32	24	64	32	12	4
03/18/74	46	29	60	40	10	3
03/20/74	27	20	72	56	8	4
03/22/74	10	8	108	60	7	1
03/25/74	13	12	80	-	7	7
03/27/74	18	15	-	-	10	6
03/29/74	30	19	80	56	16	3
04/01/74	30	22	88	68	14	5
04/03/74	31	16	80	-	9	4
04/05/74	14	12	60	-	-	-
04/08/74	25	14	60	-	12	-
04/10/74	25	16	-	52	15	5
04/12/74	23	11	80	-	-	-
04/15/74	35	28	80	60	16	3
04/17/74	61	45	100	64	31	8
04/19/74	42	33	124	-	19	-
04/22/74	51	51	-	52	31	6
04/24/74	41	39	100	52	20	2
04/26/74	42	31	100	-	32	6
04/29/74	22	20	92	40	15	3
05/01/74	17	15	-	-	10	3
05/03/74	30	26	80	56	13	3
05/06/74	33	28	-	-	18	5
05/08/74	48	35	95	60	18	4
05/10/74	79	33	97	48	16	3
05/13/74	28	20	73	52	15	3
05/15/74	36	30	77	42	17	7
05/17/74	-	-	89	60	12	3
05/20/74	35	33	79	46	14	4
05/22/74	33	26	75	50	11	4
05/23/74	32	27	65	33	15	3
05/28/74	30	24	64	44	6	3
05/29/74	20	12	67	57	7	4
05/31/74	24	14	51	32	7	3
06/03/74	28	16	65	48	9	4
06/05/74	22	9	59	47	9	4
06/07/74	22	17	88	47	8	4
06/10/74	25	20	60	38	8	2
06/12/74	17	13	62	40	9	4
06/14/74	26	12	76	56	9	3
06/17/74	-	-	-	-	-	-
06/19/74	31	24	74	42	8	4
06/21/74	20	12	55	31	14	8

APPENDIX C (continued)

Date	Total SS mg/l	Volatile SS mg/l	Total COD mg/l	Soluble COD mg/l	Total BOD ₅ mg/l	Soluble BOD ₅ mg/l
06/24/74	27	15	70	51	9	4
06/26/74	22	20	53	43	8	4
06/28/74	20	6	47	35	7	3
07/01/74	26	13	53	44	9	5
07/03/74	26	19	55	50	6	3
07/05/74	23	13	80	54	10	3
07/08/74	30	25	65	44	13	7
07/10/74	23	13	65	57	9	7
07/12/74	20	8	59	51	9	4
07/15/74	-	-	-	-	-	-
07/17/74	34	18	64	60	12	9
07/19/74	25	14	72	52	9	5
07/22/74	21	11	82	37	11	7
07/24/74	20	13	61	59	13	7
07/26/74	21	14	65	38	5	6
07/29/74	23	18	63	50	9	6
07/31/74	19	11	90	67	7	6
08/02/74	26	17	80	60	8	7
08/05/74	32	22	81	62	14	8
08/07/74	30	20	85	58	21	11
08/09/74	23	20	83	60	9	5
08/12/74	26	16	89	55	16	7
08/14/74	31	21	89	69	15	7
08/16/74	18	12	83	67	12	4
08/19/74	17	15	88	74	14	5
08/21/74	17	14	90	56	8	6
08/23/74	15	13	92	44	10	4
08/26/74	21	13	102	68	25	18
08/29/74	21	10	82	60	25	17
08/31/74	10	9	67	53	28	22
09/03/74	-	-	-	-	-	-
09/05/74	42	38	83	38	12	4
09/07/74	39	35	80	40	11	2
09/10/74	36	31	118	56	21	10
09/12/74	28	21	112	56	21	10
09/14/74	29	11	82	50	18	11
09/17/74	-	-	-	-	-	-
09/19/74	38	25	103	67	21	10
09/21/74	43	42	109	67	20	10
09/24/74	24	23	93	58	13	5
09/26/74	24	21	83	56	18	10
09/28/74	25	16	92	58	15	6
10/01/74	20	19	92	67	17	9
10/03/74	25	21	88	63	22	12
10/05/74	26	23	80	48	12	7
10/08/74	42	42	93	60	10	5
10/10/74	28	22	91	58	23	17
10/12/74	22	20	112	54	22	9
10/15/74	24	24	84	56	14	4
10/17/74	32	32	76	57	20	11
10/19/74	41	36	109	53	12	7
10/22/74	42	32	88	51	14	5
10/24/74	42	38	101	62	20	10
10/26/74	30	30	100	46	24	18
10/29/74	34	26	107	52	22	7
10/31/74	-	-	-	-	-	-
11/02/74	-	-	-	-	-	-
11/05/74	NOT IN OPERATION					
11/07/74	NOT IN OPERATION					
11/09/74	49	44	131	75	11	3
11/12/74	37	29	89	48	15	6
11/14/74	29	28	70	46	14	4
11/16/74	40	40	93	58	15	5
11/19/74	29	26	91	52	22	8
11/21/74	30	30	95	56	19	7

APPENDIX C (continued)

Date	Total SS mg/l	Volatile SS mg/l	Total COD mg/l	Soluble COD mg/l	Total BOD ₅ mg/l	Soluble BOD ₅ mg/l
11/23/74	37	29	94	48	13	2
11/26/74	28	24	90	52	14	4
11/28/74	23	23	92	48	16	2
11/30/74	30	28	88	50	9	4
12/03/74	35	26	87	52	13	3
12/05/74	26	22	87	67	7	1
12/07/74	21	17	78	48	9	2
12/10/74	26	21	80	56	12	3
12/12/74	18	12	-	-	11	2
12/14/74	18	18	74	52	8	2
12/17/74	15	12	48	48	8	2
12/19/74	12	12	107	56	9	2
12/21/74	15	15	62	61	7	1
12/24/74	19	15	78	39	11	2
12/26/74	20	14	86	47	11	3
12/28/74	27	19	90	49	12	2
12/31/74	20	20	75	44	11	3
01/02/75	29	23	78	56	14	4
01/04/75	24	16	84	58	11	3
01/07/75	27	22	96	55	15	3
01/09/75	27	25	100	55	16	3
01/11/75	31	28	93	51	12	2
01/14/75	35	30	93	57	13	2
01/16/75	26	20	88	50	13	3
01/18/75	37	30	90	56	20	4
01/21/75	41	36	104	44	28	4
01/23/75	39	36	108	60	20	4
01/24/75	39	31	98	53	24	4
01/27/75	42	40	121	47	27	5
01/29/75	41	32	97	68	24	4
01/31/75	42	37	111	48	25	5
02/03/75	39	34	99	56	26	6
02/05/75	33	29	92	52	25	8
02/07/75	41	37	111	54	25	6
02/10/75	48	42	109	69	26	5
02/12/75	26	24	84	54	27	3
02/14/75	31	28	94	61	17	4
02/17/75	29	29	91	52	16	3
02/19/75	43	35	106	52	25	7
02/21/75	29	24	82	54	14	4
02/24/75	26	26	99	54	20	5
02/26/75	31	25	98	58	21	5
02/28/75	35	34	104	60	29	7
03/03/75	68	61	138	52	35	3
03/05/75	62	58	128	56	42	6
03/07/75	52	44	143	54	31	4
03/11/75	49	46	116	46	31	5
03/13/75	42	40	114	48	25	4
03/15/75	28	22	86	39	16	7
03/17/75	45	24	108	48	42	7
03/19/75	-	-	181	56	31	7
03/21/75	17	-	127	68	25	5
03/24/75	48	48	132	54	30	7
03/27/75	59	48	111	54	24	8
03/29/75	54	38	84	54	21	8
03/31/75	38	38	84	58	17	6
04/02/75	40	25	85	49	16	6
04/04/74	69	26	85	51	15	6
04/07/75	2	2	145	90	19	5
04/09/75	5	5	111	54	15	6
04/11/75	43	24	92	72	23	6
04/14/75	37	20	114	62	29	9

APPENDIX C (continued)

Date	Total SS mg/l	Volatile SS mg/l	Total COD mg/l	Soluble COD mg/l	Total BOD ₅ mg/l	Soluble BOD ₅ mg/l
04/16/75	36	34	-	71	36	16
04/18/75	35	34	111	62	25	10
04/21/75	46	38	119	64	24	8
04/23/75	33	27	110	62	30	12
04/25/75	28	28	106	64	23	8
04/28/75	25	25	104	60	29	12
04/30/75	39	36	129	61	31	6
05/02/75	42	41	121	63	32	14
05/05/75	38	35	117	46	22	9
05/08/75	47	47	109	60	34	13
05/10/75	32	30	165	70	37	18
05/14/75	40	38	128	72	-	-
05/16/75	-	-	-	-	-	-

Date	Water Temp °C	Dissolved Oxygen mg/l	pH	Ammonia mg/l as N	Total Phosphorus mg/l as P
01/25/74	4.5	-	-	9.0	6.7
01/28/74	4.5	-	6.8	9.5	6.0
01/30/74	-	-	8.1	10.0	7.5
02/01/74	4.0	-	7.6	13.0	7.1
02/04/74	3.5	-	7.7	13.5	6.5
02/06/74	4.0	-	7.7	14.0	6.3
02/08/74	2.0	-	7.6	15.0	7.5
02/11/74	5.0	-	7.0	12.5	7.7
02/13/74	6.0	-	7.4	12.0	7.9
02/15/74	-	-	7.7	12.0	8.0
02/18/74	6.0	-	7.6	19.5	7.3
02/20/74	7.0	-	7.8	17.0	8.0
02/22/74	6.5	-	7.6	15.5	7.6
02/25/74	4.5	-	7.5	16.5	7.4
02/27/74	7.5	-	8.1	16.0	7.1
03/01/74	7.0	-	8.6	18.0	6.9
03/04/74	12.0	-	7.5	9.5	5.8
03/06/74	12.0	-	7.9	10.0	7.1
03/08/74	17.0	-	8.4	6.5	6.9
03/11/74	11.0	-	7.5	7.5	6.4
03/13/74	8.5	-	8.0	8.5	5.0
03/15/74	9.0	-	8.0	8.0	5.6
03/18/74	10.5	-	7.5	4.0	5.7
03/20/74	8.0	-	7.7	5.2	5.7
03/22/74	7.0	-	7.5	10.0	7.6
03/24/74	6.8	-	7.6	6.8	6.0
03/27/74	10.0	-	7.7	6.6	5.8
03/29/74	14.0	-	8.3	2.3	5.4

APPENDIX C (continued)

Date	Water Temp °C	Dissolved Oxygen mg/l	pH	Ammonia mg/l as N	Total Phosphorus mg/l as P
04/01/74	14.5	11.5	7.5	5.0	6.5
04/03/74	18.0	8.8	7.7	8.5	6.5
04/05/74	10.5	7.5	7.4	8.0	6.8
04/08/74	11.3	6.3	7.4	6.0	6.7
04/10/74	12.5	10.0	8.1	5.5	6.4
04/12/74	15.0	12.5	7.5	4.7	6.3
04/15/74	10.5	7.0	-	5.9	6.1
04/17/74	14.0	8.3	8.6	3.0	5.4
04/19/74	15.0	1.5	8.5	4.0	5.2
04/22/74	18.0	4.5	-	2.9	5.0
04/24/74	16.0	3.5	8.5	3.3	4.7
04/26/74	18.0	8.0	-	2.0	4.3
04/29/74	18.9	1.5	8.3	6.0	3.5
05/01/74	19.0	1.0	8.3	2.3	3.1
05/03/74	19.0	2.5	8.5	1.4	2.9
05/06/74	18.1	0.5	7.9	1.1	2.8
05/08/74	19.0	0.3	8.8	1.4	2.7
05/10/74	19.0	0.1	8.4	0.7	2.6
05/13/74	20.8	0.1	8.4	1.6	2.6
05/15/74	19.0	0.1	8.4	1.9	2.8
05/17/74	-	0.5	-	1.5	2.9
05/20/74	25.0	1.2	8.2	1.0	2.6
05/22/74	24.5	0.2	8.4	1.0	2.4
05/23/74	25.0	0.1	8.4	0.95	2.4
05/28/74	22.9	0.1	8.5	0.90	2.6
05/29/74	25.0	0.1	8.5	0.90	2.6
05/31/74	25.0	0.0	8.4	1.00	2.4
06/03/74	25.0	0.3	8.4	0.74	2.1
06/05/74	23.0	0.1	8.4	0.95	2.2
06/07/74	23.5	0.1	8.3	0.58	2.2
06/10/74	18.8	0.1	8.3	1.85	2.6
06/12/74	22.5	0.1	8.3	0.85	2.4
06/14/74	24.0	0.1	8.4	2.60	2.3
06/17/74	-	-	-	-	-
06/19/74	26.3	0.1	8.2	0.60	2.1
06/21/74	26.8	0.1	8.0	1.50	2.1
06/24/74	25.5	0.0	8.5	0.80	1.9
06/26/74	25.9	0.2	-	0.85	1.8
06/28/74	25.8	0.1	8.7	1.10	1.6
07/01/74	26.2	0.3	8.1	1.20	1.7
07/03/74	26.1	0.1	8.3	1.75	1.7
07/05/74	27.6	1.2	8.4	1.20	1.7
07/08/74	29.0	0.1	8.4	0.90	1.5
07/10/74	29.5	0.5	8.3	0.92	1.6
07/12/74	28.3	0.0	8.2	1.30	1.5
07/15/74	-	-	-	-	-
07/17/74	28.5	0.0	8.4	1.60	1.6
07/19/74	29.6	0.5	8.4	0.69	1.6
07/22/74	31.1	1.2	8.4	1.50	1.7
07/24/74	29.1	0.2	8.1	2.60	1.7
07/26/74	28.0	1.0	8.0	3.00	1.7
07/29/74	28.9	0.3	8.1	1.25	1.5
07/31/74	27.8	0.3	8.3	1.50	1.7
08/02/74	26.4	0.2	8.2	2.30	1.7
08/05/74	24.5	0.7	8.3	1.80	1.6
08/07/74	23.0	0.5	8.1	3.00	1.8
08/09/74	24.6	0.5	8.2	3.50	1.7
08/12/74	26.0	0.5	8.2	2.60	1.7
08/14/74	25.9	0.3	8.2	1.80	1.6
08/16/74	25.8	0.3	8.1	-	-
08/19/74	25.7	0.1	8.2	3.70	1.8
08/21/74	26.4	0.0	8.3	2.10	1.5

APPENDIX C (continued)

Date	Water Temp °C	Dissolved Oxygen mg/l	pH	Ammonia mg/l as N	Total Phosphorus mg/l as P
08/23/74	25.4	0.1	8.4	1.12	-
08/26/74	25.8	0.1	8.3	2.00	2.0
08/29/74	22.5	0.6	8.0	5.15	2.7
08/31/74	21.8	0.2	8.1	2.70	1.5
09/03/74	-	-	-	-	-
09/05/74	18.7	1.7	9.1	3.65	1.5
09/07/74	18.3	1.0	8.4	0.90	1.6
09/10/74	23.2	0.8	9.2	0.95	1.9
09/12/74	23.3	0.2	8.4	0.60	1.8
09/14/74	18.0	0.0	8.2	2.60	2.3
09/17/74	-	-	-	-	-
09/19/74	21.1	0.1	8.4	1.15	2.1
09/21/74	19.2	0.1	8.4	1.50	2.3
09/24/74	18.0	0.2	8.6	1.00	2.4
09/26/74	17.5	0.0	8.6	0.54	2.3
09/28/74	18.2	0.1	8.0	0.85	2.7
10/01/74	16.2	0.2	8.5	2.05	2.4
10/03/74	15.1	0.1	9.0	2.52	2.2
10/05/74	16.0	0.1	8.3	2.50	3.1
10/08/74	14.7	0.2	8.4	-	2.9
10/10/74	15.9	0.2	8.4	2.57	3.5
10/12/74	17.2	0.1	8.4	1.88	3.6
10/15/74	13.8	0.0	8.2	3.30	3.9
10/17/74	14.4	0.0	8.3	2.06	3.1
10/19/74	14.1	0.1	8.2	1.88	4.2
10/22/74	13.2	0.5	8.4	2.16	4.2
10/24/74	15.2	0.0	8.0	-	-
10/26/74	16.1	0.0	8.2	1.80	-
10/29/74	15.8	0.0	8.0	1.80	4.1
10/31/74	-	-	-	-	-
11/02/74					
11/05/74					
11/07/74					
11/09/74	9.0	3.0	7.0	0.54	2.0
11/12/74	7.8	0.0	7.6	1.50	3.0
11/14/74	6.8	0.8	7.8	-	3.0
11/16/74	7.0	0.5	7.6	1.32	2.6
11/19/74	8.6	0.1	7.5	0.93	2.2
11/21/74	8.5	0.0	7.8	1.10	3.2
11/23/74	12.1	-	7.6	0.84	5.5
11/26/74	6.3	0.2	7.7	2.00	6.7
11/28/74	7.8	0.7	7.6	1.40	3.0
11/30/74	3.5	3.7	8.1	1.65	3.0
12/03/74	4.0	2.6	8.0	0.90	2.5
12/05/74	5.8	3.0	8.3	0.68	2.6
12/07/74	5.3	4.9	7.8	0.78	2.7
12/10/74	3.8	2.3	8.0	0.58	3.2
12/12/74	4.7	1.6	7.9	0.90	2.8
12/14/74	3.8	3.8	8.1	0.82	3.2
12/17/74	2.8	2.8	7.6	0.82	3.1
12/19/74	4.0	1.7	7.9	0.68	2.9
12/21/74	3.2	1.5	8.0	0.54	3.4
12/24/74	3.2	4.6	8.1	-	3.3
12/26/74	3.5	5.1	8.1	0.58	2.9
12/28/74	3.0	5.9	8.1	0.44	3.0
12/31/74	4.5	2.7	8.1	0.40	3.1
01/02/75	2.8	6.2	8.0	0.54	3.3
01/04/75	3.0	5.8	8.2	0.58	3.3
01/07/75	3.2	8.2	8.2	0.44	3.4
01/09/75	3.2	4.3	8.3	0.58	3.0
01/11/75	0.5	7.2	8.0	1.30	5.7
01/14/75	1.4	4.3	8.2	1.35	4.0
01/16/75	2.0	4.1	8.2	-	5.1
01/18/75	3.0	3.6	8.3	1.25	4.7

NOT IN OPERATION

APPENDIX C (continued)

Date	Water Temp °C	Dissolved Oxygen mg/l	pH	Ammonia mg/l as N	Total Phosphorus mg/l as P
01/21/75	3.4	4.9	8.0	0.97	5.9
01/23/75	2.1	4.1	8.3	0.93	5.2
01/24/75	3.2	5.6	8.3	0.83	3.6
01/27/75	3.0	4.5	8.0	0.98	4.2
01/29/75	2.5	5.0	7.9	1.10	3.9
01/31/75	3.0	2.5	8.2	1.13	3.8
02/03/75	3.0	3.0	8.3	1.44	4.1
02/05/75	2.0	3.0	8.0	1.56	4.2
02/07/75	2.0	6.0	8.2	1.38	4.5
02/10/75	3.0	10.0	8.5	1.36	4.4
02/12/75	2.0	1.5	8.0	1.50	4.7
02/14/75	1.0	2.0	8.1	1.56	4.5
02/17/75	-	0.5	7.8	1.87	5.3
02/19/75	3.0	8.6	8.4	1.44	4.4
02/21/75	4.0	2.2	8.1	1.76	8.9
02/24/75	3.0	1.6	7.9	2.15	8.2
02/26/75	-	3.9	7.7	2.09	5.8
02/28/75	5.0	4.0	7.9	1.85	6.8
03/03/75	4.0	10.4	8.3	0.96	3.7
03/05/75	6.0	11.0	8.2	0.91	4.8
03/07/75	6.5	5.0	7.4	1.31	4.8
03/11/75	4.1	5.7	8.4	1.12	5.3
03/13/75	4.2	8.7	8.5	1.29	4.3
03/15/75	5.6	10.6	8.5	1.12	3.6
03/17/75	12.0	6.0	8.2	0.51	3.1
03/19/75	7.0	2.0	8.9	0.39	2.4
03/21/75	12.0	2.0	8.5	2.00	2.3
03/24/75	8.0	3.0	8.4	0.95	2.9
03/27/75	6.8	3.7	8.4	1.02	2.4
03/29/75	6.5	4.2	8.6	1.48	-
03/31/75	7.0	5.5	8.5	2.52	4.2
04/02/75	7.0	2.5	8.4	1.25	2.8
04/04/75	7.0	8.7	8.7	1.25	2.4
04/07/75	10.0	2.0	8.6	1.60	1.8
04/09/75	9.5	1.0	8.5	1.71	2.6
04/11/75	9.0	1.5	8.7	2.11	3.0
04/14/75	11.0	1.0	8.6	2.05	2.3
04/16/75	13.0	1.0	8.5	1.54	2.2
04/18/75	17.0	1.5	8.5	1.78	2.2
04/21/75	16.0	4.0	-	1.22	1.8
04/23/75	18.0	0	8.0	1.47	2.0
04/25/75	18.0	0	8.4	1.34	1.6
04/28/75	19.0	0	8.5	1.62	1.9
04/30/75	20.0	0	8.4	2.50	1.8
05/02/75	-	-	-	1.90	2.0
05/05/75	19.0	0	-	1.60	2.1
05/08/75	20.0	0	8.5	1.80	2.3
05/10/75	21.0	2.5	8.0	3.60	1.8
05/14/75	19.2	-	7.85	2.80	2.1
05/16/75	21.0	2.5	8.8	-	-

APPENDIX D. WATER QUALITY, EFFLUENT FROM SMALL ROCK FILTER

Date	Total SS mg/l	Volatile SS mg/l	Total COD mg/l	Soluble COD mg/l	Total BOD ₅ mg/l	Soluble BOD ₅ mg/l
01/25/74	38	34	-	24	27	10
01/28/74	44	41	-	40	23	9
01/30/74	51	47	180	60	24	6
02/01/74	52	45	196	20	26	9
02/04/74	47	46	120	52	32	4
02/06/74	47	44	120	52	25	6
02/08/74	54	51	104	76	26	7
02/11/74	50	48	132	56	21	6
02/13/74	51	45	104	20	25	6
02/15/74	42	41	136	52	22	6
02/18/74	41	39	188	28	20	6
02/20/74	54	52	120	92	18	6
02/22/74	61	52	144	60	13	6
02/25/74	60	58	140	56	13	7
02/27/74	59	55	144	20	13	5
03/01/74	114	83	160	40	14	6
03/04/74	82	68	-	-	18	6
03/06/74	94	76	144	44	23	4
03/08/74	85	47	152	40	25	7
03/11/74	52	36	120	80	17	-
03/13/74	32	25	84	24	9	6
03/15/74	42	33	100	52	14	3
03/18/74	24	17	60	44	7	5
03/20/74	15	14	76	56	6	5
03/22/74	12	10	80	40	7	2
03/25/74	16	13	92	80	15	9
03/27/74	14	13	-	80	7	6
03/29/74	21	11	104	68	10	6
04/01/74	17	9	80	64	9	5
04/03/74	16	13	-	-	10	5
04/05/74	15	12	-	56	17	8
04/08/74	23	14	-	-	13	8
04/10/74	28	19	-	48	18	4
04/12/74	19	19	80	-	-	-
04/15/74	24	23	84	44	14	3
04/17/74	31	26	96	-	18	4
04/19/74	35	29	120	44	27	12
04/22/74	40	31	100	-	16	5
04/24/74	26	33	76	52	14	3
04/26/74	24	16	84	68	22	6
04/29/74	22	22	56	40	15	3
05/01/74	8	8	76	64	10	3
05/03/74	27	23	88	60	10	2
05/06/74	29	17	-	-	17	6
05/08/74	53	38	79	54	19	4
05/10/74	81	38	87	52	17	4
05/13/74	28	22	85	44	19	4
05/15/74	31	15	73	44	14	5
05/17/74	40	22	69	52	8	4
05/20/74	29	28	75	50	16	4
05/22/74	41	32	60	30	15	3
05/23/74	38	33	65	53	9	2
05/28/74	30	21	56	48	7	4
05/29/74	20	12	61	48	5	3
05/31/74	17	8	48	32	8	3
06/03/74	26	10	69	48	7	3
06/05/74	18	11	59	39	9	6
06/07/74	22	19	61	47	9	5
06/10/74	20	13	62	40	6	3
06/12/74	19	13	62	44	7	4
06/14/74	24	14	66	52	8	4
06/17/74	-	-	-	-	-	-
06/19/74	34	27	72	44	12	5
06/21/74	24	16	63	27	12	8

APPENDIX D (continued)

Date	Total SS mg/l	Volatile SS mg/l	Total COD mg/l	Soluble COD mg/l	Total BOD ₅ mg/l	Soluble BOD ₅ mg/l
06/24/74	22	11	64	43	8	4
06/26/74	17	14	53	43	6	4
06/28/74	19	9	55	55	6	3
07/01/74	22	11	51	48	7	3
07/03/74	23	16	55	53	5	2
07/05/74	19	9	62	46	5	2
07/08/74	17	13	52	48	7	5
07/10/74	25	13	73	49	10	6
07/12/74	22	11	55	51	9	6
07/15/74	-	-	-	-	-	-
07/17/74	26	12	68	62	14	7
07/19/74	21	12	60	52	6	4
07/22/74	23	14	62	41	13	5
07/24/74	23	16	86	63	14	5
07/26/74	25	21	61	50	8	7
07/29/74	29	14	63	50	7	4
07/31/74	27	19	100	54	8	5
08/02/74	27	18	84	56	10	7
08/05/74	37	28	79	62	10	7
08/07/74	37	24	81	58	18	8
08/09/74	28	26	79	48	10	8
08/12/74	28	22	89	55	11	7
08/14/74	31	21	79	61	17	9
08/16/74	14	11	83	51	10	5
08/19/74	25	21	82	62	11	4
08/21/74	23	18	86	44	7	7
08/23/74	24	21	92	60	8	4
08/26/74	30	20	102	60	15	5
08/29/74	19	11	74	48	19	13
08/31/74	23	23	85	47	20	13
09/03/74	-	-	-	-	-	-
09/05/74	44	39	85	41	15	5
09/07/74	36	34	74	52	8	2
09/10/74	34	28	106	68	18	8
09/12/74	28	20	104	60	23	12
09/14/74	27	3	80	46	19	13
09/17/74	-	-	-	-	-	-
09/19/74	41	31	101	51	16	7
09/21/74	23	15	91	55	17	6
09/24/74	19	17	76	66	10	4
09/26/74	16	12	68	64	19	16
09/28/74	14	12	81	62	18	9
10/01/74	13	13	81	71	14	6
10/03/74	16	11	82	59	25	19
10/05/74	23	19	80	46	16	7
10/08/74	12	6	89	60	10	6
10/10/74	19	16	77	52	24	22
10/12/74	10	8	92	56	20	7
10/15/74	19	19	76	64	11	3
10/17/74	16	16	74	66	23	14
10/19/74	19	17	78	55	23	14
10/22/74	24	17	84	53	13	5
10/24/74	28	23	86	60	26	16
10/26/74	19	19	93	62	18	8
10/29/74	22	15	95	60	23	12
10/31/74	-	-	-	-	-	-
11/02/74						
11/05/74						
11/07/74						
11/09/74	39	34	106	58	13	1
11/12/74	37	29	81	46	11	3
11/14/74	26	26	83	50	11	3
11/16/74	28	28	73	66	15	5

NOT IN OPERATION

APPENDIX D (continued)

Date	Total SS mg/l	Volatile SS mg/l	Total COD mg/l	Soluble COD mg/l	Total BOD ₅ mg/l	Soluble BOD ₅ mg/l
11/19/74	17	16	85	39	13	3
11/21/74	19	19	79	48	15	3
11/23/74	27	21	80	48	14	3
11/26/74	24	21	84	54	16	3
11/28/74	30	28	82	50	19	4
11/30/74	46	34	84	52	11	3
12/03/74	42	35	99	60	20	2
12/05/74	17	17	105	44	6	1
12/07/74	55	49	122	54	21	1
12/10/74	60	52	128	58	28	4
12/12/74	45	38	-	-	27	1
12/14/74	46	41	126	56	25	3
12/17/74	46	41	107	40	25	2

Date	Water Temp °C	Dissolved Oxygen mg/l	pH	Ammonia mg/l as N	Total Phosphorus mg/l as P
01/25/74	4.5	-	-	10.0	6.5
01/28/74	4.5	-	6.6	9.5	7.8
01/30/74	-	-	8.1	9.0	7.2
02/01/74	4.5	-	7.5	12.5	6.7
02/04/74	3.5	-	7.7	13.5	6.8
02/06/74	3.5	-	7.7	15.0	5.9
02/08/74	2.0	-	7.6	16.0	7.5
02/11/74	5.0	-	7.0	13.0	7.7
02/13/74	6.0	-	7.4	12.5	7.6
02/15/74	-	-	7.6	12.0	8.0
02/18/74	6.0	-	7.6	20.0	7.5
02/20/74	7.5	-	7.8	17.5	7.5
02/22/74	6.5	-	7.5	17.0	7.4
02/25/74	4.5	-	7.5	16.0	7.5
02/27/74	7.5	-	8.2	15.5	7.3
03/01/74	7.0	-	8.7	14.5	6.9
03/04/74	12.0	-	7.5	10.0	6.3
03/06/74	12.0	-	7.8	9.5	7.3
03/08/74	14.0	-	7.9	7.5	6.2
03/11/74	11.0	-	7.5	9.0	5.8
03/13/74	9.0	-	8.1	10.5	5.4
03/15/74	9.0	-	8.2	5.9	5.2
03/18/74	10.5	-	7.5	8.0	5.7
03/20/74	8.0	-	7.9	9.0	5.9
03/22/74	7.0	-	7.6	14.0	6.2
03/25/74	6.8	-	7.6	9.5	6.3
03/27/74	9.5	-	7.5	9.5	6.3
03/29/74	13.0	-	8.2	5.0	5.4

APPENDIX D (continued)

Date	Water Temp °C	Dissolved Oxygen mg/l	pH	Ammonia mg/l as N	Total Phosphorus mg/l as P
04/01/74	14.5	10.0	7.6	4.5	6.1
04/03/74	18.0	9.6	7.9	10.0	6.4
04/05/74	11.0	4.9	7.3	9.0	7.0
04/08/74	11.3	5.5	7.5	9.7	6.7
04/10/74	13.0	9.8	8.0	5.5	6.5
04/12/74	14.0	13.0	7.4	7.2	9.0
04/15/74	10.5	5.8	-	7.0	6.1
04/17/74	13.5	13.2	8.3	5.3	5.9
04/19/74	15.1	1.8	8.3	4.9	4.6
04/22/74	18.0	3.5	-	6.4	5.0
04/24/74	16.0	6.2	8.4	4.6	4.3
04/26/74	18.0	5.0	-	4.7	4.0
04/29/74	19.0	1.8	8.4	5.3	3.1
05/01/74	19.0	2.0	8.3	2.8	3.0
05/03/74	19.0	1.2	8.4	1.8	2.9
05/06/74	18.5	1.3	8.0	1.1	2.9
05/08/74	19.0	0.3	8.7	1.5	2.6
05/10/74	19.5	0.1	8.4	0.8	2.5
05/13/74	20.8	0.1	8.4	1.6	2.5
05/15/74	19.5	0.2	8.3	2.4	2.8
05/17/74	-	0.5	-	1.8	2.6
05/20/74	24.5	1.0	8.1	1.3	2.6
05/22/74	24.7	0.2	8.4	1.2	2.6
05/23/74	25.1	0.5	8.3	1.2	2.4
05/28/74	22.9	0.1	8.5	0.90	2.6
05/29/74	25.0	0.2	8.3	1.00	2.8
05/31/74	25.0	0.0	8.4	1.20	2.2
06/03/74	25.0	0.3	8.4	1.00	1.9
06/05/74	23.0	0.1	8.3	1.20	2.3
06/07/74	23.8	0.1	8.3	0.83	2.2
06/10/74	18.9	0.1	8.2	2.00	2.5
06/12/74	22.5	0.1	8.2	2.00	2.4
06/14/74	24.9	0.1	8.2	2.70	2.3
06/17/74	-	-	-	-	-
06/19/74	26.7	0.3	8.3	0.65	1.9
06/21/74	26.5	0.0	8.0	1.40	2.0
06/24/74	25.9	0.0	8.5	1.10	2.0
06/26/74	26.1	0.0	-	1.95	1.7
06/28/74	26.0	0.1	8.7	1.60	1.7
07/01/74	26.2	0.2	8.1	1.50	1.7
07/03/74	26.2	0.1	8.2	1.85	1.7
07/05/74	27.8	0.5	8.3	1.40	1.5
07/08/74	29.4	0.0	8.5	0.96	1.4
07/10/74	29.6	0.1	8.4	1.70	1.6
07/12/74	28.8	0.0	8.3	1.70	1.5
07/15/74	-	-	-	-	-
07/17/74	28.2	0.0	8.3	2.60	1.6
07/19/74	30.0	0.2	8.4	1.30	1.5
07/22/74	31.2	0.2	8.4	1.65	1.6
07/24/74	29.0	0.5	8.3	3.40	1.5
07/26/74	28.4	0.4	8.3	3.20	1.7
07/29/74	28.9	0.5	8.2	1.70	1.8
07/31/74	28.0	0.3	8.4	1.80	1.7
08/02/74	26.6	0.3	8.3	3.60	1.8
08/05/74	24.6	0.7	8.3	1.70	1.7
08/07/74	23.1	0.5	8.1	3.30	1.8
08/09/74	24.9	0.5	8.4	2.40	1.5
08/12/74	25.5	0.7	8.2	3.10	1.8
08/14/74	25.3	0.2	8.2	2.10	1.7
08/16/74	25.9	0.8	8.2	-	-
08/19/74	26.0	0.2	8.3	2.30	1.9
08/21/74	26.8	0.1	8.5	1.40	1.5
08/23/74	25.4	0.2	8.4	1.60	-
08/26/74	25.9	0.2	8.4	1.00	2.2

APPENDIX D (continued)

Date	Water Temp °C	Dissolved Oxygen mg/l	pH	Ammonia mg/l as N	Total Phosphorus mg/l as P
08/29/74	22.4	0.2	8.1	5.15	2.1
08/31/74	22.0	0.1	8.3	2.4	1.6
09/03/74	-	-	-	-	-
09/05/74	19.1	0.4	9.0	-	1.4
09/07/74	18.1	0.5	8.1	-	1.6
09/10/74	23.4	0.8	9.1	0.90	2.1
09/12/74	23.7	0.2	8.2	0.75	1.8
09/14/74	18.4	0.0	8.4	2.60	2.1
09/17/74	-	-	-	-	-
09/19/74	20.5	0.2	8.4	1.05	2.3
09/21/74	19.8	0.2	8.4	1.11	3.6
09/24/74	18.0	0.2	8.6	1.35	2.0
09/26/74	18.7	0.0	8.6	0.75	2.4
09/28/74	18.5	0.1	7.9	1.25	3.0
10/01/74	16.4	0.2	8.5	2.55	2.2
10/03/74	15.4	0.2	8.8	1.50	2.3
10/05/74	16.0	0.1	8.4	3.10	3.1
10/08/74	14.7	0.2	8.3	-	2.9
10/10/74	15.7	0.1	8.3	2.57	3.1
10/12/74	17.0	0.1	8.4	3.63	3.4
10/15/74	13.8	0.0	8.2	3.30	3.8
10/17/74	14.7	0.1	8.2	3.30	3.1
10/19/74	14.0	0.3	8.4	2.79	3.6
10/22/74	13.0	0.0	8.3	2.57	4.1
10/24/74	15.4	0.1	8.0	2.79	-
10/26/74	16.2	0.0	8.0	2.06	-
10/29/74	15.8	0.0	8.0	2.67	4.2
10/31/74	-	-	-	-	-
11/02/74					
11/05/74					
11/07/74					
11/09/74	9.1	2.1	8.0	0.85	2.0
11/12/74	7.3	2.7	7.7	1.16	2.2
11/14/74	6.0	6.3	7.9	1.27	2.6
11/16/74	6.8	2.7	7.6	1.65	3.0
11/19/74	9.1	1.7	7.6	1.97	3.2
11/21/74	8.5	0.7	7.8	2.34	3.4
11/23/74	12.0	-	7.6	2.16	5.6
11/26/74	5.5	4.2	7.9	3.50	11.2
11/28/74	7.5	8.3	7.7	3.40	3.8
11/30/74	3.0	1.6	8.2	3.20	4.0
12/03/74	4.0	9.2	8.3	3.9	4.0
12/05/74	6.0	14.4	8.3	3.2	4.6
12/07/74	5.0	19.4	8.3	2.95	3.3
12/10/74	4.0	19.9	8.7	2.73	2.8
12/12/74	5.2	11.8	8.8	2.9	2.8
12/14/74	3.8	14.4	8.7	3.2	3.0
12/17/74	2.2	12.2	8.1	2.5	3.0

NOT IN OPERATION

APPENDIX D (continued)

Date	Water Temp °C	Dissolved Oxygen mg/l	pH	Ammonia mg/l as N	Total Phosphorus mg/l as P
08/29/74	22.4	0.2	8.1	5.15	2.1
08/31/74	22.0	0.1	8.3	2.4	1.6
09/03/74	-	-	-	-	-
09/05/74	19.1	0.4	9.0	-	1.4
09/07/74	18.1	0.5	8.1	-	1.6
09/10/74	23.4	0.8	9.1	0.90	2.1
09/12/74	23.7	0.2	8.2	0.75	1.8
09/14/74	18.4	0.0	8.4	2.60	2.1
09/17/74	-	-	-	-	-
09/19/74	20.5	0.2	8.4	1.05	2.3
09/21/74	19.8	0.2	8.4	1.11	3.6
09/24/74	18.0	0.2	8.6	1.35	2.0
09/26/74	18.7	0.0	8.6	0.75	2.4
09/28/74	18.5	0.1	7.9	1.25	3.0
10/01/74	16.4	0.2	8.5	2.55	2.2
10/03/74	15.4	0.2	8.8	1.50	2.3
10/05/74	16.0	0.1	8.4	3.10	3.1
10/08/74	14.7	0.2	8.3	-	2.9
10/10/74	15.7	0.1	8.3	2.57	3.1
10/12/74	17.0	0.1	8.4	3.63	3.4
10/15/74	13.8	0.0	8.2	3.30	3.8
10/17/74	14.7	0.1	8.2	3.30	3.1
10/19/74	14.0	0.3	8.4	2.79	3.6
10/22/74	13.0	0.0	8.3	2.57	4.1
10/24/74	15.4	0.1	8.0	2.79	-
10/26/74	16.2	0.0	8.0	2.06	-
10/29/74	15.8	0.0	8.0	2.67	4.2
10/31/74	-	-	-	-	-
11/02/74					
11/05/74					
11/07/74					
11/09/74	9.1	2.1	8.0	0.85	2.0
11/12/74	7.3	2.7	7.7	1.16	2.2
11/14/74	6.0	6.3	7.9	1.27	2.6
11/16/74	6.8	2.7	7.6	1.65	3.0
11/19/74	9.1	1.7	7.6	1.97	3.2
11/21/74	8.5	0.7	7.8	2.34	3.4
11/23/74	12.0	-	7.6	2.16	5.6
11/26/74	5.5	4.2	7.9	3.50	11.2
11/28/74	7.5	8.3	7.7	3.40	3.8
11/30/74	3.0	1.6	8.2	3.20	4.0
12/03/74	4.0	9.2	8.3	3.9	4.0
12/05/74	6.0	14.4	8.3	3.2	4.6
12/07/74	5.0	19.4	8.3	2.95	3.3
12/10/74	4.0	19.9	8.7	2.73	2.8
12/12/74	5.2	11.8	8.8	2.9	2.8
12/14/74	3.8	14.4	8.7	3.2	3.0
12/17/74	2.2	12.2	8.1	2.5	3.0

NOT IN OPERATION

APPENDIX E. WATER QUALITY, DOWNSTREAM TUBE, SMALL ROCK FILTER

Date	Total SS mg/l	Volatile SS mg/l	Total COD mg/l	Soluble COD mg/l	Total BOD ₅ mg/l	Soluble BOD ₅ mg/l
04/08/74	3	2	-	-	-	-
04/12/74	6	4	-	-	-	-
04/15/74	19	17	-	-	-	-
04/19/74	28	27	-	-	-	-
04/26/74	16	14	-	-	-	-
04/29/74	22	16	-	-	-	-
05/03/74	21	19	-	-	-	-
05/06/74	35	26	63	61	-	-
05/10/74	40	30	138	36	-	-
05/17/74	30	17	72	54	-	-
05/20/74	22	16	82	66	-	-
05/23/74	26	17	89	46	-	-
05/31/74	15	11	57	51	-	-
06/03/74	19	12	74	55	-	-
06/07/74	23	12	69	47	-	-
06/10/74	23	14	63	43	-	-
06/14/74	17	10	70	68	-	-
06/21/74	21	18	71	56	-	-
06/24/74	19	15	80	50	-	-
07/12/74	13	7	-	-	-	-
07/19/74	12	12	-	-	-	-
07/29/74	12	5	-	-	-	-
08/23/74	7	6	-	-	-	-
08/31/74	10	1	-	-	-	-
09/03/74	-	-	-	-	-	-
09/05/74	51	43	119	38	14	14
09/07/74	29	26	94	42	9	3
09/10/74	43	37	108	60	19	9
09/12/74	27	21	104	58	20	12
09/14/74	34	14	92	40	12	6
09/17/74	-	-	-	-	-	-
09/19/74	40	24	97	51	20	13
09/21/74	37	23	113	67	15	4
09/24/74	25	25	87	54	17	8
09/26/74	15	12	80	56	20	16
09/28/74	15	12	85	58	14	4
10/01/74	19	18	92	67	18	10
10/03/74	22	18	94	55	20	12
10/05/74	16	13	99	76	39	>25
10/08/74	27	21	93	60	11	6
10/10/74	22	17	79	69	30	>23
10/12/74	15	14	104	56	25	13
10/15/74	21	19	86	66	24	14
10/17/74	19	-	84	70	23	16
10/19/74	22	20	90	55	26	12
10/22/74	18	15	93	51	22	10
10/24/74	27	25	89	64	28	15
10/26/74	30	30	104	54	23	18
10/29/74	32	24	107	60	20	13
10/31/74	-	-	-	-	-	-
11/02/74						
11/05/74						
11/07/74						
11/09/74	48	43	121	48	8	2
11/12/74	15	11	91	58	20	12
11/14/74	12	11	95	50	44	>24
11/16/74	18	17	110	46	31	>23
11/19/74	7	7	112	46	36	30
11/21/74	10	10	112	54	37	31
11/23/74	17	10	108	52	31	18
11/26/74	12	11	102	50	55	54
11/28/74	7	6	96	48	40	30
11/30/74	13	13	92	40	39	29

NOT IN OPERATION

APPENDIX E (continued)

	Total SS	Volatile SS	Total COD	Soluble COD	Total BOD ₅	Soluble BOD ₅
Date	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
12/03/74	12	8	95	75	42	34
12/05/74	10	8	95	87	29	16
12/07/74	8	7	98	90	42	33
12/10/74	13	9	100	86	46	31
12/12/74	6	4	-	-	19	13
12/14/74	5	5	100	84	8	3
12/17/74	6	6	-	-	16	7

	Water Temp O°	Dissolved Oxygen mg/l	ph	Ammonia mg/l as N	Total Phosphorus mg/l as P
Date					
04/08/74	10.8	0.1	-	-	-
04/12/74	14.0	0.3	-	-	-
04/15/74	11.0	0.2	-	-	-
04/19/74	14.9	0.1	-	-	-
04/26/74	17.7	0.0	-	-	-
04/29/74	18.7	0.0	-	-	-
05/03/74	19.4	0.0	-	-	-
05/06/74	18.8	0.0	-	-	-
05/10/74	20.0	0.0	-	-	-
05/17/74	-	-	-	-	-
05/20/74	25.4	0.0	-	-	-
05/23/74	25.2	0.0	-	-	-
05/31/74	25.6	0.0	-	-	-
06/03/74	25.0	0.0	-	-	-
06/07/74	23.8	0.0	-	-	-
06/10/74	19.9	0.0	-	-	-
06/14/74	24.2	0.0	-	-	-
06/21/74	26.4	0.0	-	-	-
06/24/74	25.8	0.0	-	-	-
07/12/74	29.0	0.0	-	-	-
07/19/74	30.3	0.0	8.2	2.30	-
07/29/74	29.1	0.0	8.0	3.90	-
08/23/74	25.7	0.0	7.9	-	-
08/31/74	22.3	0.0	8.0	-	-
09/03/74	-	-	-	-	-
09/05/74	17.3	0.6	8.9	0.98	1.6
09/07/74	17.7	0.5	8.5	0.90	1.8
09/10/74	23.4	0.2	9.6	0.74	1.9
09/12/74	23.2	0.2	7.8	0.70	2.2
09/14/74	18.0	0.1	7.9	2.00	2.1

APPENDIX E (continued)

Date	Water Temp °°	Dissolved Oxygen mg/l	ph	Ammonia mg/l as N	Total Phosphorus mg/l as P
09/17/74	-	-	-	-	-
09/19/74	20.1	0.1	8.2	3.00	2.1
09/21/74	20.0	0.0	8.3	1.25	2.3
09/24/74	17.5	0.1	8.5	1.00	2.7
09/26/74	17.5	0.2	9.2	0.71	2.4
09/28/74	18.2	0.1	8.0	1.75	2.7
10/01/74	16.3	0.2	8.4	1.75	2.3
10/03/74	15.6	0.1	-	1.40	2.2
10/05/74	16.0	0.0	8.2	-	-
10/08/74	15.0	0.1	8.2	1.75	3.0
10/10/74	16.0	0.2	8.2	2.70	3.5
10/12/74	17.0	0.1	8.1	3.22	3.6
10/15/74	15.0	0.1	8.0	3.42	3.5
10/17/74	14.5	0.0	8.1	2.70	2.8
10/19/74	15.1	0.3	8.2	2.86	4.2
10/22/74	14.0	0.1	8.1	2.21	4.5
10/24/74	14.8	0.0	7.8	2.86	-
10/26/74	15.3	0.1	8.2	2.53	-
10/29/74	15.9	0.0	8.0	2.42	4.1
10/31/74	-	-	-	-	-
11/02/74					
11/05/74					
11/07/74					
11/09/74	8.9	1.0	8.0	0.65	2.0
11/12/74	9.3	0.0	7.5	3.40	6.5
11/14/74	9.0	0.2	7.6	5.80	4.2
11/16/74	8.0	0.1	7.3	4.50	4.4
11/19/74	8.0	0.0	7.4	5.10	4.2
11/21/74	8.0	0.0	7.6	3.80	3.9
11/23/74	9.2	0.1	7.3	4.90	2.4
11/26/74	8.6	0.1	7.5	8.20	10.0
11/28/74	8.2	0.2	7.3	9.00	8.7
11/30/74	3.4	0.9	7.5	8.60	6.1
12/03/74	6.2	0.3	7.6	10.04	4.6
12/05/74	4.0	0.3	8.1	10.15	4.6
12/07/74	6.0	0.3	7.9	10.30	4.4
12/10/74	5.0	0.3	7.6	10.00	4.4
12/12/74	4.1	0.2	7.6	7.2	3.8
12/14/74	3.9	0.1	7.8	2.8	3.7
12/17/74	3.0	0.0	7.5	3.5	3.4

NOT IN OPERATION

APPENDIX F. WATER QUALITY, DOWNSTREAM TUBE, LARGE ROCK FILTER

Date	Total SS mg/l	Volatile SS mg/l	Total COD mg/l	Soluble COD mg/l	Total BOD ₅ mg/l	Soluble BOD ₅ mg/l
04/08/74	7	4	-	-	-	-
04/12/74	12	8	-	-	-	-
04/15/74	28	25	-	-	-	-
04/19/74	39	35	-	-	-	-
04/26/74	35	31	-	-	-	-
04/29/74	24	19	-	-	-	-
05/03/74	19	18	-	-	-	-
05/06/74	34	28	50	46	-	-
05/10/74	49	35	98	46	-	-
05/17/74	30	18	82	68	-	-
05/20/74	20	13	82	58	-	-
05/23/74	31	22	78	53	-	-
05/31/74	21	13	50	44	-	-
06/03/74	35	20	56	54	-	-
06/07/74	23	10	55	46	-	-
06/10/74	27	14	62	51	-	-
06/14/74	27	19	70	63	-	-
06/21/74	28	15	84	49	-	-
06/24/74	34	24	75	54	-	-
07/12/74	14	2	-	-	-	-
07/19/74	11	9	-	-	-	-
07/29/74	9	8	-	-	-	-
08/23/74	14	10	-	-	-	-
08/31/74	23	17	-	-	-	-
09/03/74	-	-	-	-	-	-
09/05/74	45	39	91	36	13	4
09/07/74	32	30	72	36	7	2
09/10/74	33	27	118	64	24	15
09/12/74	23	17	108	64	25	17
09/14/74	29	14	96	48	17	9
09/17/74	-	-	-	-	-	-
09/19/74	35	25	111	63	20	11
09/21/74	30	25	107	65	16	5
09/24/74	22	22	85	54	17	18
09/26/74	51	30	93	60	20	13
09/28/74	19	14	100	54	19	9
10/01/74	20	20	92	67	20	13
10/03/74	22	18	97	61	24	15
10/05/74	26	19	92	69	25	19
10/08/74	20	18	99	54	9	4
10/10/74	27	24	91	62	28	22
10/12/74	21	20	100	54	29	18
10/15/74	26	25	80	52	17	5
10/17/74	27	27	82	62	23	16
10/19/74	35	29	98	47	20	7
10/22/74	37	28	103	54	16	7
10/24/74	36	30	99	54	23	12
10/26/74	34	34	112	54	27	20
10/29/74	44	36	122	60	18	10
10/31/74	-	-	-	-	-	-
11/02/74	-	-	-	-	-	-
11/05/74	-	-	-	-	-	-
11/07/74	-	-	-	-	-	-
11/09/74	52	46	100	46	12	1
11/12/74	39	50	112	52	12	4
11/14/74	39	38	87	75	13	4
11/16/74	46	43	95	54	15	4
11/19/74	39	37	87	62	16	4
11/21/74	42	39	97	58	16	3
11/23/74	49	41	112	84	17	3
11/26/74	38	34	108	78	13	2
11/28/74	32	32	100	74	14	3
11/30/74	41	39	96	84	10	3
12/03/74	40	32	103	54	13	2

NOT IN OPERATION

APPENDIX F (continued)

Date	Total SS mg/l	Volatile SS mg/l	Total COD mg/l	Soluble COD mg/l	Total BOD ₅ mg/l	Soluble BOD ₅ mg/l
12/05/74	31	28	107	56	8	<1
12/07/74	30	26	92	46	11	2
12/10/74	26	22	88	50	15	2
12/12/74	26	22	-	-	13	3
12/14/74	21	19	90	54	8	2
12/17/74	26	20	64	48	10	2
12/19/74	18	15	82	76	-	-
12/21/74	18	18	72	45	8	1
12/24/74	16	16	68	37	10	2
12/26/74	19	14	86	49	14	5
12/28/74	29	11	74	51	11	2
12/31/74	22	22	67	47	15	5
01/02/75	-	-	60	56	13	4
01/04/75	-	-	76	64	17	4
01/07/75	24	21	91	47	15	3
01/09/75	28	28	100	45	15	4
01/11/75	29	26	97	51	16	3
01/14/75	29	22	91	51	15	2
01/16/75	30	28	88	48	16	4
01/18/75	36	30	118	54	19	4
01/21/75	41	34	112	42	25	4
01/23/75	67	64	133	54	29	5
01/24/75	43	37	118	45	33	4
01/27/75	55	48	147	69	32	5
01/29/75	53	44	141	62	37	8
01/31/75	56	48	123	50	27	6
02/03/75	53	46	113	52	32	5
02/05/75	-	-	-	-	-	-
02/07/75	67	59	119	60	90	11
02/10/75	118	109	211	69	41	7
02/12/75	43	35	173	48	36	4
02/14/75	43	42	96	53	24	6
02/17/75	41	41	107	57	22	4
02/19/75	43	34	120	55	25	7
02/21/75	46	43	122	54	22	4
02/24/75	37	35	111	52	29	5
02/26/75	55	49	103	52	36	6
02/28/75	51	50	115	52	34	7
03/03/75	51	47	120	52	26	3
03/05/75	52	51	134	76	29	4
03/07/75	63	54	135	54	32	4
03/11/75	53	51	125	58	26	4
03/13/75	52	50	118	50	29	4
03/15/75	50	44	121	39	28	6
03/17/75	53	32	153	36	35	8
03/19/75	85	73	143	58	35	6
03/21/75	58	-	189	46	42	5
03/24/75	54	54	151	56	33	4
03/27/75	65	43	103	44	22	6
03/29/75	35	26	109	50	29	6
03/31/75	48	48	128	56	26	6
04/02/75	65	40	156	51	34	6
04/04/75	111	65	148	53	32	8
04/07/75	48	48	203	101	36	5
04/09/75	35	35	201	56	42	6
04/11/75	54	32	126	54	24	6
04/14/75	82	54	179	72	45	13
04/16/75	49	48	-	71	37	10
04/18/75	86	83	216	62	38	6
04/21/75	63	59	147	64	26	7
04/23/75	55	51	145	66	27	8
04/25/75	52	51	124	56	34	9
04/28/75	32	32	108	60	23	9
04/30/75	36	35	107	54	27	4

APPENDIX F (continued)

Date	Total SS mg/l	Volatile SS mg/l	Total COD mg/l	Soluble COD mg/l	Total BOD ₅ mg/l	Soluble BOD ₅ mg/l
05/02/75	41	41	125	49	25	9
05/05/75	70	62	147	50	30	3
05/08/75	29	29	115	56	31	15
05/10/75	46	40	121	54	28	12
05/14/75	20	20	190	162	-	-

Date	Water Temp O°	Dissolved Oxygen mg/l	pH	Ammonia mg/l as N	Total Phosphorus mg/l as P
04/08/74	10.7	0.3	-	-	-
04/12/74	14.0	8.8	-	-	-
04/15/74	10.9	0.2	-	-	-
04/19/74	16.2	0.2	-	-	-
04/26/74	17.6	0.0	-	-	-
04/29/74	18.2	0.0	-	-	-
05/03/74	18.2	0.0	-	-	-
05/06/74	18.2	0.0	-	-	-
05/10/74	18.7	0.0	-	-	-
05/17/74	-	-	-	-	-
05/20/74	24.0	0.0	-	-	-
05/23/74	24.1	0.0	-	-	-
05/31/74	24.2	0.0	-	-	-
06/03/74	24.4	0.0	-	-	-
06/07/74	23.3	0.0	-	-	-
06/10/74	19.0	0.0	-	-	-
06/14/74	24.1	0.0	-	-	-
06/21/74	25.7	0.0	-	-	-
06/24/74	25.5	0.0	-	-	-
07/12/74	28.5	0.0	-	-	-
07/19/74	30.1	0.0	8.1	3.75	-
07/29/74	29.1	0.0	7.9	3.10	-
08/23/74	25.6	0.0	8.1	-	-
08/31/74	22.0	0.0	8.0	-	-
09/03/74	-	-	-	-	-
09/05/74	17.8	0.2	9.0	3.90	1.6
09/07/74	18.3	0.0	8.3	1.10	1.4
09/10/74	23.2	0.1	9.0	1.95	2.1
09/12/74	23.5	0.2	7.8	0.90	1.9
09/14/74	18.9	0.1	8.0	2.70	2.1
09/17/74	-	-	-	-	-
09/19/74	20.1	0.0	8.4	1.20	2.1
09/21/74	20.0	0.0	8.2	1.51	2.2
09/24/74	17.8	0.0	8.5	1.00	2.0
09/26/74	17.2	0.1	9.2	0.44	2.6
09/28/74	19.9	0.1	7.8	0.90	2.7
10/01/74	16.5	0.2	8.4	2.00	2.3
10/03/74	15.1	0.2	8.7	2.49	2.4
10/05/74	16.9	0.0	8.1	-	3.5
10/08/74	15.0	0.1	8.2	3.00	3.4
10/10/74	16.0	0.2	8.2	2.39	3.1
10/12/74	17.8	0.1	8.2	3.12	3.8

APPENDIX F (continued)

Date	Water Temp °°	Dissolved Oxygen mg/l	pH	Ammonia mg/l as N	Total Phosphorus mg/l as P
10/15/74	14.8	0.1	8.1	2.70	3.9
10/17/74	14.3	0.1	8.1	2.85	3.6
10/19/74	14.8	0.2	8.1	2.39	4.2
10/22/74	13.8	0.1	8.2	2.50	4.1
10/24/74	14.9	0.0	8.1	2.39	-
10/26/74	16.0	0.0	8.1	2.08	-
10/29/74	15.9	0.0	8.1	2.27	4.1
10/31/74	-	-	-	-	-
11/02/74					
11/05/74					
11/07/74					
11/09/74	9.0	2.0	7.9	0.27	2.1
11/12/74	9.3	0.0	7.6	1.65	3.0
11/14/74	7.2	0.4	8.0	0.84	7.7
11/16/74	6.9	0.0	7.6	0.60	2.1
11/19/74	8.9	0.1	7.5	-	2.5
11/21/74	7.8	0.1	7.8	-	2.6
11/23/74	10.9	0.0	7.7	0.65	3.4
11/26/74	6.5	0.5	7.8	0.52	4.0
11/28/74	6.0	1.3	7.6	0.34	2.9
11/30/74	1.9	2.5	7.8	0.30	2.2
12/03/74	3.6	2.2	7.9	0.40	3.5
12/05/74	5.7	3.2	7.7	0.46	3.0
12/07/74	5.2	1.5	8.0	0.29	2.7
12/10/74	3.5	3.6	8.0	0.26	3.5
12/12/74	3.5	2.0	7.8	0.26	2.9
12/14/74	3.2	2.2	8.1	0.65	3.0
12/17/74	3.0	2.4	7.9	0.40	3.2
12/19/74	3.1	0.9	7.9	0.46	3.2
12/21/74	3.2	1.1	8.1	0.40	3.1
12/24/74	3.2	1.6	7.9	-	3.2
12/26/74	2.8	1.3	7.9	0.58	3.1
12/28/74	3.0	0.9	7.8	0.66	3.3
12/31/74	3.7	0.4	7.9	0.50	3.2
01/02/75	3.1	1.4	8.2	0.61	3.0
01/04/75	3.1	1.5	7.9	0.52	3.2
01/07/75	3.6	-	8.0	0.86	3.2
01/09/75	3.2	1.8	8.1	0.76	3.1
01/11/75	1.0	1.8	7.8	1.90	3.7
01/14/75	1.5	1.1	8.1	1.80	3.6
01/16/75	1.1	3.0	8.2	1.20	4.8
01/18/75	3.5	2.0	8.2	1.15	5.2
01/21/75	3.6	2.6	7.8	1.05	5.2
01/23/75	2.3	4.2	8.2	.83	5.6
01/24/75	3.3	3.9	8.2	.94	3.6
01/27/75	3.0	2.5	8.2	2.58	3.2
01/29/75	2.0	1.5	7.9	1.02	3.9
01/31/75	1.5	1.5	8.2	.83	3.7
02/03/75	2.0	1.0	8.1	1.17	3.8
02/05/75	-	-	-	-	-
02/07/75	0.1	2.0	7.9	1.31	4.4
02/10/75	1.5	3.0	8.3	1.23	4.9
02/12/75	1.0	1.0	8.1	0.90	4.3
02/14/75	0.2	0.5	8.0	1.17	4.1
02/17/75	-	1.0	7.7	1.67	4.0
02/19/75	3.0	1.0	8.1	0.67	4.2
02/21/75	4.0	0.9	8.0	1.12	7.4
02/24/75	2.0	1.0	8.0	1.44	6.1
02/26/75	-	1.0	7.7	1.33	5.2
02/28/75	5.0	0.5	7.8	1.27	6.6
03/03/75	3.5	0.5	7.7	1.61	4.3
03/05/75	6.0	1.0	7.9	1.00	4.4
03/07/75	6.0	0.5	7.4	1.30	4.0
03/11/75	4.2	0.6	8.2	-	3.8
03/13/75	3.9	1.4	8.2	-	2.2

APPENDIX F (continued)

Date	water	Dissolved		Ammonia	Total
	Temp °C	Oxygen mg/l	pH	mg/l as N	Phosphorus mg/l as P
03/15/75	4.5	2.6	8.3	-	3.3
03/17/75	9.0	1.5	8.9	0.35	3.4
03/19/75	10.0	0.5	8.2	1.33	4.8
03/21/75	12.0	0.5	8.7	0.52	3.9
03/24/75	8.0	0.5	8.5	1.04	2.0
03/27/75	7.0	2.0	8.6	0.69	0.9
03/29/75	4.7	1.9	7.7	0.48	4.2
03/31/75	6.0	3.5	8.4	0.44	2.5
04/02/75	7.0	1.5	8.1	0.45	2.2
04/04/75	7.0	2.0	8.8	0.48	2.5
04/07/75	10.0	1.0	8.7	0.76	2.3
04/09/75	10.0	1.0	8.5	0.73	2.2
04/11/75	10.0	1.0	8.8	0.87	1.8
04/14/75	10.0	1.0	8.8	1.22	2.1
04/16/75	13.0	.5	8.7	0.83	2.1
04/18/75	17.0	.5	8.6	1.22	2.2
04/21/75	15.0	0	8.8	0.87	2.0
04/23/75	19.0	0	8.5	1.10	2.0
04/25/75	19.0	0	8.5	1.54	2.1
04/28/75	18.0	0	8.5	1.87	2.0
04/30/75	20.0	0	8.3	1.35	2.0
05/02/75	-	-	-	1.00	2.0
05/05/75	21.0	0	-	0.23	1.6
05/08/75	20.0	0	8.6	1.60	1.8
05/10/75	23.0	0.5	8.5	1.50	2.0
05/14/75	22.2	-	7.2	7.60	3.7

APPENDIX G. WATER QUALITY, CENTER TUBE, SMALL ROCK FILTER

Date	Water Temp O°	Dissolved Oxygen mg/l	pH	Total SS mg/l	Volatile SS mg/l	Ammonia mg/l as N
05/20/74	25.5	0.0	-	27	15	-
05/23/74	25.2	0.0	-	32	21	-
05/31/74	25.7	0.0	-	19	16	-
06/03/74	24.8	0.0	-	22	16	-
06/07/74	23.6	0.0	-	26	16	-
06/10/74	19.0	0.0	-	28	24	-
06/14/74	24.6	0.0	-	20	15	-
06/21/74	26.3	0.0	-	24	18	-
06/24/74	25.4	0.0	-	26	20	-
07/12/74	29.0	0.3	8.4	14	10	1.87
07/19/74	30.3	0.2	8.3	14	12	-
07/29/74	30.0	0.1	8.0	8	6	3.70
08/31/74	-	-	8.0	13	7	-
09/07/74	19.0	8.2	8.7	58	50	-
09/14/74	17.9	1.9	8.3	47	44	-
09/21/74	20.0	0.0	8.4	27	25	1.25
09/28/74	18.9	0.2	7.5	14	11	2.22
10/05/74	16.8	0.1	8.1	12	11	2.60
10/12/74	18.0	0.2	8.2	27	24	2.43
10/19/74	14.9	0.3	8.3	35	30	1.80
10/26/74	16.3	0.8	8.6	59	53	1.70
11/09/74	9.0	7.7	8.2	64	52	0.24
11/16/74	5.8	0.3	7.5	58	50	0.90
11/23/74	10.3	0.3	7.7	52	28	1.35
11/30/74	1.7	2.6	7.8	23	21	0.70
12/07/74	3.8	0.5	7.7	15	12	1.38
12/14/74	3.2	2.2	8.1	18	15	-

APPENDIX G (continued) UPSTREAM TUBE, SMALL ROCK FILTER

Date	Water Temp O°	Dissolved Oxygen mg/l	pH	Total SS mg/l	Volatile SS mg/l	Ammonia mg/l as N
04/08/74	10.6	0.8	-	35	26	-
04/12/74	13.8	1.6	-	38	30	-
04/15/74	11.0	1.8	-	47	39	-
04/19/74	16.2	3.2	-	90	78	-
04/26/74	18.8	0.4	-	82	67	-
04/29/74	19.0	3.0	-	65	53	-
05/03/74	19.5	0.7	-	130	119	-
05/06/74	18.1	1.8	-	87	73	-
05/10/74	18.2	0.2	-	237	181	-
05/17/74	-	-	-	242	208	-
05/20/74	25.8	0.8	-	65	58	-
05/23/74	24.2	0.1	-	62	48	-
05/31/74	24.0	1.4	-	31	25	-
06/03/74	24.0	2.2	-	37	29	-
06/07/74	23.0	1.8	-	46	31	-
06/10/74	18.9	5.2	-	48	38	-

APPENDIX G (continued) UPSTREAM TUBE, SMALL ROCK FILTER

Date	Water	Dissolved	pH	Total	Volatile	Ammonia
	Temp °	Oxygen mg/l		SS mg/l	SS mg/l	
06/14/74	24.8	3.5	-	49	42	-
06/21/74	26.0	3.6	-	49	43	-
06/24/74	25.0	3.8	-	43	39	-
07/12/74	27.9	1.9	8.7	32	24	<0.1
07/19/74	30.9	4.1	8.6	40	36	-
07/29/74	29.9	0.1	8.1	31	24	2.90
08/31/74	-	-	8.5	98	70	-
09/07/74	21.0	13.0	8.7	60	53	-
09/14/74	18.7	4.7	8.2	92	82	0.38
09/21/74	20.9	3.2	8.7	118	92	1.15
09/28/74	17.9	0.3	8.0	198	143	5.00
10/05/74	17.0	0.5	8.2	177	109	-
10/12/74	17.9	0.5	8.3	211	142	1.37
10/19/74	15.9	10.6	8.8	197	120	1.33
10/26/74	18.8	13.0	8.8	90	78	0.34
11/09/74	9.0	9.5	8.2	64	51	0.66
11/16/74	6.7	8.0	7.8	79	54	0.29
11/23/74	11.9	10.4	7.9	162	87	0.33
11/30/74	1.2	8.8	8.3	45	34	0.45
12/07/74	5.0	15.5	8.0	90	81	0.82
12/14/74	3.3	8.4	8.2	36	31	-

APPENDIX C (continued) CENTER TUBE, LARGE ROCK FILTER

Date	Water Temp °C	Dissolved Oxygen mg/l	pH	Total SS mg/l	Volatile SS mg/l	Ammonia mg/l as N
05/20/74	24.1	0.0	-	23	10	-
05/23/74	25.0	0.0	-	31	21	-
05/31/74	25.0	0.0	-	28	17	-
06/03/74	24.3	0.0	-	26	18	-
06/07/74	23.4	0.0	-	24	14	-
06/10/74	18.4	0.0	-	26	16	-
06/14/74	23.8	0.0	-	32	26	-
06/21/74	26.1	0.0	-	31	22	-
06/24/74	25.2	0.0	-	29	23	-
07/12/74	28.9	0.2	8.4	19	8	1.67
07/19/74	30.1	0.2	8.2	15	15	-
07/29/74	29.2	0.1	8.0	13	9	2.90
08/31/74	-	-	8.1	19	15	-
09/07/74	18.2	0.5	8.4	40	37	-
09/14/74	18.6	0.1	8.2	32	31	-
09/21/74	19.8	0.1	8.2	29	24	1.01
09/28/74	18.0	0.6	7.9	19	15	3.35
10/05/74	17.0	0.3	8.1	13	12	9.00
10/12/74	18.0	0.2	8.2	32	27	3.13
10/19/74	14.3	0.0	8.3	46	39	2.55
10/26/74	16.0	0.1	8.3	55	49	1.45
11/09/74	9.0	5.5	7.9	66	53	0.18
11/16/74	6.9	3.8	7.7	80	65	0.18
11/23/74	11.0	4.5	7.6	52	44	0.66
11/30/74	1.9	6.3	8.2	42	37	0.41
12/07/74	5.0	6.2	7.8	40	35	0.63
12/14/74	3.7	6.4	8.2	26	24	0.58
12/21/74	4.0	3.8	7.9	31	16	0.94
12/28/74	3.4	4.6	8.0	37	22	0.46
01/04/75	3.3	1.5	8.0	41	29	0.44
01/11/75	0.5	12.1	8.2	61	44	1.75
01/18/75	3.2	9.8	8.6	52	47	1.05
01/24/75	3.3	10.0	8.5	67	56	1.20
02/03/75	2.0	2.5	8.3	66	59	1.27
02/07/75	1.0	4.5	8.1	64	60	1.23
02/14/75	1.0	2.5	8.1	74	71	1.57
02/21/75	4.0	3.2	8.2	65	57	1.08
02/28/75	5.0	3.0	7.9	74	72	1.63
03/07/75	6.0	1.0	7.4	102	89	1.80
03/15/75	4.5	2.6	8.3	72	62	0.21
03/17/75	9.0	4.5	8.1	65	40	0.46
03/19/75	9.0	5.0	8.4	98	88	1.05
03/21/75	12.0	1.5	8.8	37	-	0.32
03/24/75	8.0	2.0	8.6	52	52	0.27
03/27/75	7.1	2.5	8.7	87	65	-
03/29/75	6.2	4.0	8.5	83	67	0.53
03/31/75	7.0	6.5	8.4	62	57	0.51
04/02/75	6.8	5.5	8.4	63	40	0.45
04/04/75	7.0	5.0	8.9	111	65	0.42
04/07/75	10.0	1.5	8.7	78	49	0.66
04/09/75	10.0	2.0	8.5	38	36	0.69
04/11/75	11.0	3.5	8.8	64	43	0.82
04/14/75	11.0	1.0	8.7	75	54	0.95
04/16/75	14.0	2.0	8.7	46	46	0.57
04/18/75	17.0	1.0	8.7	88	77	1.05
04/21/75	15.0	0	8.9	64	56	0.75
04/23/75	19.0	0	8.6	57	53	1.05
04/25/75	18.0	0	8.6	60	57	1.24
04/28/75	18.0	0	8.7	42	42	1.62
04/30/75	18.0	0	8.6	55	50	0.72
05/02/75	-	-	-	56	55	0.90
05/05/75	21.0	0	-	75	67	0.57
05/08/75	20.0	0	9.0	60	59	0.04
05/10/75	23.0	3.0	8.9	69	64	0.02
05/14/75	18.4	-	8.25	79	75	0.03

APPENDIX G (continued) UPSTREAM TUBE, LARGE ROCK FILTER

Date	Water Temp O°	Dissolved Oxygen mg/l	pH	Total SS mg/l	Volatile SS mg/l	Ammonia mg/l as N
04/08/74	10.7	1.7	-	34	25	-
04/12/74	14.3	4.8	-	33	25	-
04/15/74	10.6	1.1	-	58	52	-
04/19/74	15.0	2.2	-	79	66	-
04/26/74	17.6	0.5	-	52	45	-
04/29/74	18.5	1.9	-	59	52	-
05/03/74	18.9	0.8	-	77	59	-
05/06/74	18.1	0.9	-	64	57	-
05/10/74	18.5	1.0	-	122	78	-
05/17/74	-	-	-	70	51	-
05/20/74	24.2	0.3	-	23	14	-
05/23/74	24.7	0.3	-	66	57	-
05/31/74	24.6	0.2	-	68	60	-
06/03/74	24.0	0.9	-	40	36	-
06/07/74	23.2	1.2	-	49	34	-
06/10/74	18.6	1.4	-	50	40	-
06/14/74	24.2	0.2	-	48	40	-
06/21/74	25.9	1.6	-	49	40	-
06/24/74	24.9	2.4	-	50	42	-
07/12/74	27.9	2.3	8.6	27	12	<0.1
07/19/74	29.9	1.5	8.7	35	30	-
07/29/74	29.0	0.2	8.2	23	19	2.55
08/31/74	-	-	8.1	32	28	-
09/07/74	19.9	8.4	8.7	56	50	-
09/14/74	18.0	2.3	8.3	83	73	-
09/21/74	19.9	1.2	8.6	63	56	0.80
09/28/74	19.0	0.1	8.1	93	78	4.20
10/05/74	16.4	0.5	8.4	133	112	8.50
10/12/74	17.3	0.8	8.5	81	66	2.20
10/19/74	15.9	6.2	8.6	252	154	2.80
10/26/74	16.9	6.4	8.6	90	79	0.90
11/09/74	9.2	8.5	8.1	71	59	0.27
11/16/74	7.4	7.0	7.8	66	54	0.36
11/23/74	11.7	8.0	7.8	66	51	0.61
11/30/74	1.8	9.2	8.2	46	41	0.51
12/07/74	5.8	13.0	7.9	45	39	0.58
12/14/74	3.9	8.5	8.2	39	34	0.66
12/21/74	4.9	1.2	8.0	16	5	1.65
12/28/74	4.0	1.7	7.9	28	14	0.90
01/04/75	3.1	6.2	8.2	33	27	0.64
01/11/75	1.0	15.8	8.2	48	38	2.05
01/18/75	3.5	14.0	8.5	55	47	1.70

APPENDIX H. CHLOROPHYLL CONCENTRATION IN $\mu\text{g/l}$

Date	Cell 3 Effluent			Rock Filter Influent			Large Rock Effluent			Small Rock Effluent		
	a	b	c	a	b	c	a	b	c	a	b	c
04/12/74	101	75	98	102	73	74	82	64	85	64	50	47
04/15/74	210	158	204	128	91	112	106	89	88	84	69	79
04/17/74	166	132	169	183	144	164	173	132	159	94	74	88
04/19/74	232	175	226	215	174	230	122	93	120	93	68	73
04/26/74	204	163	189	221	173	231	108	85	111	66	45	49
04/29/74	296	218	263	219	163	194	100	82	114	72	63	67
05/01/74	138	46	68	169	68	109	61	18	34	49	18	32
05/03/74	253	110	220	-	-	-	111	36	29	56	19	36
05/06/74	-	-	-	265	87	95	136	32	28	111	26	26
05/08/74	409	139	247	285	158	252	124	45	43	140	45	35
05/10/74	250	81	163	310	109	97	160	49	49	-	-	-
05/11/74	-	-	-	-	-	-	-	-	-	68	70	121
05/13/74	275	103	97	232	89	88	115	33	18	142	49	31
05/15/74	247	94	31	232	61	99	125	38	52	102	41	77
05/17/74	-	-	-	181	37	53	45	11	34	96	22	67
05/20/74	108	34	48	106	8	39	245	68	95	219	58	101
05/22/74	127	22	53	112	15	8	180	53	103	259	78	97
05/23/74	113	52	-	114	5	-	77	-	-	164	33	27
05/28/74	112	-	24	201	-	112	45	81	-	28	230	-
05/29/74	192	37	96	158	5	59	55	6	6	38	129	-
05/31/74	140	91	52	117	26	47	49	2	-	40	16	50
06/03/74	111	49	85	92	38	67	75	30	55	58	25	31
06/05/74	141	46	50	122	31	9	64	24	26	56	35	80
06/07/74	109	43	71	108	37	56	-	-	-	59	32	55
06/10/74	163	65	76	122	49	57	58	24	42	34	17	13
06/12/74	93	72	8	116	44	44	48	27	20	32	15	6
06/14/74	145	45	43	135	53	64	50	30	22	64	28	23
06/21/74	125	80	112	121	79	106	35	23	33	30	11	10
06/24/74	110	68	92	88	60	78	50	37	27	37	16	11
06/26/74	87	78	126	89	84	115	38	39	65	22	24	37
06/28/74	66	65	96	79	71	113	29	29	38	20	19	22
07/01/74	73	61	114	78	80	158	-	-	-	18	19	13
07/03/74	79	76	88	71	67	96	26	25	54	23	17	21
07/05/74	45	41	64	16	15	38	31	32	34	20	17	33
07/08/74	48	51	69	37	31	52	31	31	30	28	25	36
07/10/74	48	51	69	55	48	66	42	41	70	15	13	4
07/12/74	-	-	-	90	78	120	25	27	38	46	47	73
07/15/74	52	54	115	-	-	-	-	-	-	-	-	-
07/17/74	73	83	138	60	62	113	34	36	75	27	35	71
07/19/74	81	78	116	69	63	105	30	33	60	20	24	44
07/22/74	79	74	120	41	36	45	20	21	41	28	25	42
07/24/74	90	78	120	79	71	113	18	15	16	38	43	67
07/26/74	89	85	136	79	71	113	28	32	57	57	53	97
07/29/74	97	89	136	79	74	120	29	33	72	72	61	75
07/31/74	96	98	150	61	56	86	30	33	66	53	52	100
08/02/74	78	69	109	87	81	140	40	45	79	58	57	93
08/05/74	91	84	134	108	102	149	30	31	56	75	79	119
08/07/74	133	122	198	109	103	158	30	33	55	38	43	73
08/09/74	131	127	195	117	112	170	32	35	52	64	69	115
08/12/74	109	59	182	77	71	114	20	21	41	31	38	60
08/14/74	92	79	86	20	26	27	32	32	158	77	69	84
08/16/74	83	73	107	66	48	181	33	6	23	38	38	86
08/19/74	106	92	169	79	76	88	32	35	104	50	51	57
08/21/74	70	57	79	81	78	106	28	27	71	57	85	127
08/23/74	74	61	52	100	106	162	22	21	29	55	47	76
08/26/74	68	54	83	60	47	53	23	36	78	57	52	62
08/29/74	59	54	68	67	57	91	17	26	39	49	58	124
08/31/74	76	63	69	61	54	56	16	54	131	75	69	96
09/03/74	60	48	42	-	-	-	-	-	-	-	-	-
09/05/74	150	139	192	133	131	169	111	102	157	-	-	-
09/07/74	85	75	125	144	129	204	70	32	57	60	60	94

Note: - indicates no data

APPENDIX H (continued)

Date	Cell 3 Effluent			Rock Filter Influent			Large Rock Effluent			Small Rock Effluent		
	a	b	c	a	b	c	a	b	c	a	b	c
09/10/74	75	72	115	54	54	92	55	47	87	41	33	74
09/12/74	101	92	131	112	98	160	57	62	77	57	54	91
09/14/74	134	118	138	141	121	172	31	25	30	32	31	44
09/17/74	164	145	197	-	-	-	-	-	-	-	-	-
09/19/74	77	67	117	87	84	107	63	56	74	66	52	65
09/21/74	299	0	44	286	0	41	117	0	0	98	0	0
09/24/74	294	0	60	313	3	54	132	2	45	91	0	46
09/26/74	258	0	29	226	0	18	89	0	32	57	11	0
09/28/74	335	0	20	194	0	20	134	1	44	64	0	28
10/01/74	381	0	77	328	0	81	54	0	0	51	1	0
10/03/74	217	0	50	48	47	123	88	0	1	51	1	0
10/05/74	372	0	52	295	0	41	85	2	18	55	6	6
10/08/74	314	0	14	292	0	144	110	0	0	33	6	12
10/10/74	238	0	118	173	0	19	62	6	32	40	1	0
10/12/74	429	1	72	388	0	74	147	1	34	46	4	24
10/15/74	391	4	68	395	0	86	115	0	25	159	0	18
10/17/74	364	7	65	403	0	62	122	8	6	43	0	11
10/19/74	384	40	199	361	12	125	180	13	73	102	10	41
10/22/74	333	2	133	342	0	153	77	0	0	66	15	0
10/24/74	297	23	133	288	6	102	114	0	52	39	12	3
10/26/74	254	130	204	217	116	159	120	67	116	83	55	91
10/29/74	233	127	191	212	120	181	115	55	88	63	33	71
11/09/74	100	79	152	105	81	95	144	185	397	62	65	57
11/12/74	177	138	224	157	134	170	84	71	89	68	55	72
11/14/74	79	76	99	113	86	158	69	61	99	50	47	111
11/16/74	69	67	51	119	93	127	48	08	20	16	18	46
11/19/74	105	82	95	105	81	157	62	46	62	16	02	00
11/21/74	90	117	99	141	121	172	33	28	26	21	14	15
11/23/74	231	112	142	172	101	112	79	55	63	60	47	64
11/26/74	193	116	127	170	88	94	85	57	46	73	46	54
11/28/74	114	83	77	135	75	89	96	42	102	99	56	48
11/30/74	179	98	131	192	120	186	81	53	73	122	86	110
12/03/74	167	78	206	160	85	134	58	00	73	127	80	100
12/05/74	173	92	129	143	71	271	-	-	-	34	00	18
12/07/74	95	66	94	66	52	65	37	09	07	317	241	317
12/10/74	127	109	78	108	74	130	60	47	64	276	187	267
12/12/74	-	-	-	90	54	77	49	39	67	198	147	150
12/14/74	144	32	43	128	30	82	61	14	26	283	93	151
12/17/74	132	37	38	115	31	45	54	19	48	380	121	159
12/19/74	141	39	71	133	27	66	60	26	28			
12/21/74	117	31	33	132	39	57	76	22	50			
12/24/74	124	34	67	133	48	90	96	37	54			
12/26/74	145	42	55	169	67	131	108	34	48			
12/28/74	141	43	68	152	38	64	160	52	57			
12/31/74	186	59	105	208	58	99	96	38	105			
01/02/75	129	44	55	130	35	82	140	46	200			
01/04/75	226	0	282	157	71	126	133	72	82			
01/07/75	98	44	68	132	61	81	111	45	88			
01/09/75	232	106	178	303	145	228	212	106	172			
01/11/75	226	102	155	180	89	137	173	92	129			
01/14/75	245	127	193	0	194	260	144	75	92			
01/16/75	252	125	179	203	106	169	173	92	129			
01/18/75	309	153	248	273	139	204	226	115	185			
01/21/75	394	178	258	292	129	187	231	112	142			
01/23/75	381	156	214	281	109	139	233	98	122			
01/24/75	289	116	169	268	103	184	237	99	138			
01/27/75	325	134	221	313	140	245	270	122	178			
01/29/75	327	137	217	344	143	199	276	109	163			
01/31/75	187	107	147	265	144	277	208	120	154			
02/03/75	259	141	181	212	122	159	189	113	132			
02/05/75	285	153	215	265	150	191	179	97	141			
02/07/75	306	183	217	-	-	-	213	119	140			
02/10/75	287	154	244	290	160	246	231	132	189			
02/12/75	291	154	220	127	67	70	127	64	124			

APPENDIX H (continued)

Date	Cell 3 Effluent			Rock Filter Influent			Large Rock Effluent			Small Rock Effluent		
	a	b	c	a	b	c	a	b	c	a	b	c
02/14/75	116	62	103	165	89	118	95	49	56			
02/17/75	264	135	193	221	121	173	125	63	95			
02/19/75	314	167	233	235	122	153	264	138	201			
02/21/75	249	133	196	201	122	157	104	52	78			
02/24/75	346	187	277	240	128	195	101	57	76			
02/26/75	394	215	343	332	184	278	162	89	119			
02/28/75	304	224	186	268	157	245	182	114	157			
03/03/75	249	148	245	224	136	222	397	246	351			
03/05/75	275	159	238	443	93	165	295	176	261			
03/07/75	333	202	306	345	209	301	290	164	243			
03/11/75	592	99	225	559	97	220	443	93	165			
03/13/75	662	117	262	568	247	158	383	73	174			
03/15/75	547	89	236	466	88	234	201	37	110			
03/17/75	692	109	277	483	76	200	370	48	162			
03/19/75	913	111	282	308	54	180	643	104	276			
03/21/75	773	125	339	669	118	277	373	61	180			
03/24/75	670	100	300	687	113	298	475	70	170			
03/27/75	-	-	-	510	77	221	188	35	101			
03/31/75	155	92	122	138	82	132	158	90	132			
04/02/75	176	100	161	179	100	149	112	59	108			
04/04/75	159	118	121	238	150	232	48	51	69			
04/07/75	116	60	73	288	178	275	154	129	83			
04/09/75	177	116	148	205	126	192	129	82	128			
04/11/75	192	96	256	314	172	281	111	109	48			
04/14/75	210	119	152	213	135	252	155	135	109			
04/16/75	168	116	145	221	142	147	211	136	191			
04/18/75	164	91	147	221	123	203	185	108	171			
04/21/75	183	107	141	212	118	276	202	109	177			
04/23/75	199	118	110	238	137	214	219	135	205			
04/25/75	186	136	209	209	146	214	178	125	182			
04/28/75	197	155	206	128	94	130	106	72	123			
04/30/75	201	142	214	142	104	160	151	110	163			
05/02/75	250	185	267	191	132	188	174	127	184			
05/05/75	352	251	376	249	175	255	167	122	171			
05/08/75	452	331	517	326	238	375	266	200	306			
05/14/75	357	264	394	294	208	309	155	112	168			

APPENDIX H (continued)

Date	Downstream Tube Large Rock Filter			Downstream Tube Small Rock Filter		
	a	b	c	a	b	c
04/12/74	71	73	96	40	45	85
04/15/74	88	79	135	48	46	83
04/19/74	96	79	124	84	68	121
04/26/74	58	60	106	30	34	75
04/29/74	40	38	74	34	37	70
05/03/74	43	42	74	59	53	90
05/06/74	61	58	90	89	81	128
05/10/74	72	74	94	104	99	123
05/17/74	35	30	43	38	27	38
05/20/74	34	20	37	30	15	7
05/23/74	45	28	48	-	-	-
05/31/74	38	18	40	48	10	39
06/03/74	46	13	18	34	12	27
06/07/74	58	23	32	47	19	33
06/10/74	63	22	19	26	5	7
06/14/74	50	26	51	22	11	26
06/21/74	54	34	46	30	11	10
06/24/74	54	35	35	37	17	0
09/03/74	-	-	-	-	-	-
09/05/74	-	-	-	132	117	161
09/07/74	61	57	75	91	133	97
09/10/74	59	54	79	61	56	86
09/12/74	58	56	98	42	45	67
09/14/74	41	36	45	55	52	74
09/17/74	-	-	-	-	-	-
09/19/74	51	43	52	47	44	65
09/21/74	120	8	18	145	1	36
09/24/74	140	7	46	135	14	23
09/26/74	137	0	38	73	0	15
09/28/74	103	3	25	73	0	40
10/01/74	116	1	37	104	5	94
10/03/74	89	0	38	99	0	11
10/05/74	71	0	8	47	0	0
10/07/74	81	4	9	50	0	7
10/10/74	114	0	0	80	5	0
10/12/74	135	11	67	78	0	0
10/15/74	63	13	87	96	0	13
10/17/74	168	0	0	91	8	9
10/19/74	176	8	59	91	3	23
10/22/74	122	9	0	56	1	20
10/24/74	145	17	85	69	0	21
10/26/74	139	80	102	124	69	122
10/28/74	147	83	125	90	54	77
11/09/74	111	83	151	85	81	100
11/11/74	103	81	107	24	26	55
11/14/74	98	87	117	65	76	233
11/16/74	63	61	60	12	09	25
11/19/74	92	76	78	06	08	20
11/21/74	73	62	103	10	11	04
11/23/74	140	88	84	26	08	26
11/26/74	114	64	82	14	00	00
11/28/74	130	60	115	00	15	21
11/30/74	107	55	186	14	11	43
12/03/74	68	34	37	00	00	00
12/05/74	104	64	130	12	15	52
12/07/74	72	36	42	01	00	00
12/10/74	90	56	95	08	00	65
12/12/74	79	50	77	08	07	19
12/14/74	84	31	48	09	18	31
12/17/74	85	22	64	09	00	25
12/19/74	107	19	39			
12/21/74	79	30	31			
12/24/74	93	31	51			
12/26/74	116	44	86			

APPENDIX H (continued)

Date	Downstream Tube Large Rock Filter			Downstream Tube Small Rock Filter		
	a	b	c	a	b	c
12/28/74	125	41	71			
12/31/74	118	43	85			
01/02/75	127	44	78			
01/04/75	117	51	79			
01/07/75	123	61	78			
01/09/75	210	102	125			
01/11/75	182	92	143			
01/14/75	157	79	80			
01/16/75	197	102	145			
01/19/75	239	121	191			
01/21/75	295	137	220			
01/23/75	393	161	231			
01/24/75	206	76	127			
01/27/75	297	140	216			
01/29/75	376	151	252			
01/31/75	274	152	224			
02/03/75	303	165	325			
02/05/75	-	-	-			
02/07/75	267	176	200			
02/10/75	290	161	235			
02/12/75	213	115	206			
02/14/75	166	95	121			
02/17/75	223	121	172			
02/19/75	238	129	196			
02/21/75	244	137	217			
02/24/75	174	100	122			
02/26/75	334	194	301			
02/28/75	297	180	257			
03/03/75	302	195	344			
03/05/75	335	202	294			
03/07/75	446	269	396			
03/11/75	491	92	151			
03/13/75	568	118	248			
03/15/75	410	88	193			
03/17/75	376	54	153			
03/19/75	499	74	200			
03/21/75	995	180	409			
03/24/75	377	64	164			
03/27/75	305	46	150			
03/31/75	189	112	154			
04/02/75	248	142	230			
04/04/75	294	179	404			
04/07/75	434	271	434			
04/09/75	379	243	404			
04/11/75	186	110	187			
04/14/75	451	284	432			
04/16/75	352	227	333			
04/18/75	415	243	377			
04/21/75	338	192	310			
04/23/75	379	226	376			
04/25/75	332	249	352			
04/28/75	132	96	125			
04/30/75	-	-	-			
05/02/75	160	108	136			
05/05/75	268	201	272			
05/08/75	205	191	203			
05/10/75	198	146	223			
05/14/75	41	48	86			

APPENDIX I. TOTAL ALKALINITY, mg/l as CaCO₃

Date	Rock Filter Influent	LARGE ROCK FILTER				SMALL ROCK FILTER			
		Upstream Tube	Center Tube	Down- stream Tube	Effluent	Upstream Tube	Center Tube	Down- stream Tube	Effluent
07/19/74	267	261	272	278	263	264	282	276	264
07/29/74	266	284	280	287	272	280	286	284	273
09/21/74	249	251	257	262	256	257	252	258	256
09/28/74	266	-	-	272	286	-	-	260	266
10/05/74	252	-	-	276	-	-	-	266	-
10/12/74	263	-	-	-	265	-	-	-	288
10/19/74	261	270	272	-	264	264	274	-	272
10/26/74	268	262	268	-	274	258	264	-	276
11/09/74	240	252	242	-	241	242	242	-	246
11/16/74	-	246	240	-	-	241	252	-	-
11/23/74	248	246	246	-	256	252	260	-	276
11/30/74	250	252	248	-	256	250	251	-	312
12/07/74	249	252	252	-	250	238	241	-	282
12/14/74	244	-	-	-	241	-	-	-	292
12/21/74	256	264	262	-	258	-	-	-	-
12/28/74	264	260	259	-	262	-	-	-	-
01/04/75	270	264	264	-	264	-	-	-	-
01/14/75	272	264	264	-	268	-	-	-	-
01/18/75	282	280	275	-	273	-	-	-	-
01/25/75	278	267	264	-	258	-	-	-	-
01/31/75	278	266	272	-	260	-	-	-	-
02/07/75	285	270	276	-	287	-	-	-	-
02/14/75	290	281	275	-	286	-	-	-	-
02/21/75	290	279	270	-	273	-	-	-	-
02/28/75	282	272	268	-	276	-	-	-	-
03/07/75	291	282	278	-	298	-	-	-	-
03/15/75	252	236	224	-	270	-	-	-	-
03/17/75	252	241	232	-	248	-	-	-	-
03/21/75	254	-	-	-	263	-	-	-	-
03/29/75	234	236	235	-	233	-	-	-	-
04/04/75	236	232	234	-	238	-	-	-	-
04/11/75	254	248	247	-	258	-	-	-	-
04/18/75	255	268	268	-	282	-	-	-	-
04/25/75	278	274	276	-	274	-	-	-	-
05/02/75	290	282	283	-	286	-	-	-	-

APPENDIX J. ALGAE GENERA, EUDORA CELL 3 EFFLUENT organisms/ml

DATE: June 1974	21	24			
<u>Blue-Green</u>					
Oscillatoria	20,100	19,500			
<u>Green</u>					
Chlorella	61,400	295,000			
Scenedesmus	4,290	6,290			
Coelastrum	285				
Tetradesmus		571			
<u>Diatoms</u>					
Nitzschia	3,140	10,300			
<u>Pigmented Flagellates</u>					
Euglena	11	0			
<u>Debris</u>	*				
*Present					

DATE: July, 1974	1	8	15	22	29
<u>Blue-Green</u>					
Oscillatoria	7,100	15,000	15,100	11,200	20,100
<u>Green</u>					
Chlorella	243,000	99,400	82,000	62,000	50,000
Scenedesmus	2,860	255	0	1,710	0
Chlorococcum	3,700	285	285		
Actinastrum	3,700	1,140	1,140	1,140	1,430
Tetrahedron				285	571
Tetradesmus					571
<u>Diatoms</u>					
Nitzschia	5,710	2,570	2,570	2,000	2,000
<u>Pigmented Flagellates</u>					
Euglena	9,300	3,700	3,700	3,000	9,300
Chlamydomonas	3,700	3,700	3,700	3,700	3,700
Chlorogonium	9,300	3,700	3,700		
Mallomonas	3,700				
<u>Debris</u>	*				
*Present					

DATE: Aug., 1974	5	12	19	26	
<u>Blue-Green</u>					
Oscillatoria	11,000	24,000	26,600	33,400	
<u>Green</u>					
Chlorella	76,600	102,000	166,000	66,300	
Scenedesmus	571	4,290	4,570	1,430	
Chlorococcum				857	
Actinastrum	285	857	3,710		
Tetrahedron		285	571		
Tetradesmus	3,700		5,430	857	

APPENDIX J (continued)

DATE: Aug., 1974(cont'd) 5 12 19 26

Diatoms

Nitzschia 857 5,430 17,700 14,300

Pigmented
Flagellates

Euglena 8,000 8,000 3,700 9,300
Chlamydomonas 9,300 3,700 3,700 9,000

DATE: Sept. 1974 3 10 17 24

Blue-Green

Oscillatoria 33,900 19,800 23,400 15,000

Green

Chlorella 105,000 31,700 33,700 30,300
Scenedesmus 3,140 1,430 1,700 2,290
Actinastrum 857 285 857
Tetradasmus 571

Diatoms

Nitzschia 1,430 4,860 2,000
Asterionella 285 285

Pigmented
Flagellates

Euglena 9,300 3,700 3,000 3,700
Phacus 3,700 3,700
Chlamydomonas 3,700 3,700 3,700

Debris

* * *

*Present

DATE: Oct., 1974 1 8 15 22 29

Blue-Green

Oscillatoria 34,200 29,600 37,900 32,400 34,600
Anacystis 1,800 1,800

Green

Chlorella 26,600 38,000 32,000 38,300 18,000
Scenedesmus 2,860 1,430 3,430 3,140 2,860
Actinastrum 571 3,700 857 857 571
Tetrahedron 571
Tetradasmus 285 1,140

Diatoms

Nitzschia 1,430 5,710 4,000 7,710 4,290

Pigmented
Flagellates

Euglena 1,800 0 3,700 0 3,700
Phacus 3,700 3,700 3,700 3,700
Chlamydomonas 3,700 3,700 3,700 3,700
Panderina 3,700

Debris

* * * *

APPENDIX J (continued)

DATE: Nov., 1974	12	19	26	
<u>Blue-Green</u>				
Oscillatoria	31,500	38,000	27,200	
Anacystis		1,800	3,700	
<u>Green</u>				
Chlorella	46,900	35,100	45,400	
Scenedesmus	5,140	8,000	7,710	
Chlorococcum			1,400	
Actinastrum	1,400	2,300	1,400	
Tetradismus	1,400	571		
<u>Diatoms</u>				
Nitzschia	8,290	9,710	14,300	
<u>Pigmented Flagellates</u>				
Euglena		9,300		
Chlamydomonas	3,700	3,700	9,300	
<u>Debris</u> *				
*Present				
DATE: Dec., 1974	3	10	24	31
<u>Blue-Green</u>				
Oscillatoria	25,900	15,500	951	378
<u>Green</u>				
Chlorella	25,100	43,400	36,300	23,100
Scenedesmus	20,000	11,400	13,700	14,900
Chlorococcum		285		
Actinastrum	857	3,700		
Coelastrum	1,400	1,400		
Oocystis			857	
Tetrahedron	285			
<u>Diatoms</u>				
Nitzschia	11,000	10,000		
<u>Pigmented Flagellates</u>				
Euglena	9,300	9,300	3,700	9,300
Phacus	1,900	3,700	3,700	3,700
Chlamydomonas	3,700	9,300	3,700	
Polytoma				9,300
Panderina		3,700		
<u>Higher Forms</u>				
Paramecium	1,800			3,700
DATE: Jan., 1975	7	16	21	27
<u>Blue-Green</u>				
Oscillatoria	0	0	0	0
<u>Green</u>				
Chlorella	36,300	51,700	38,600	41,000
Scenedesmus	48,600	37,100	29,700	50,600
Coelastrum	4,290	1,400		
Ankistrodesmus			571	

APPENDIX J (continued)

DATE: Nov., 1974	12	19	26	
<u>Blue-Green</u>				
Oscillatoria	31,500	38,000	27,200	
Anacystis		1,800	3,700	
<u>Green</u>				
Chlorella	46,900	35,100	45,400	
Scenedesmus	5,140	8,000	7,710	
Chlorococcum			1,400	
Actinastrum	1,400	2,300	1,400	
Tetradismus	1,400	571		
<u>Diatoms</u>				
Nitzschia	8,290	9,710	14,300	
<u>Pigmented Flagellates</u>				
Euglena		9,300		
Chlamydomonas	3,700	3,700	9,300	
<u>Debris</u>				
		*		
<u>*Present</u>				
DATE: Dec., 1974	3	10	24	31
<u>Blue-Green</u>				
Oscillatoria	25,900	15,500	951	378
<u>Green</u>				
Chlorella	25,100	43,400	36,300	23,100
Scenedesmus	20,000	11,400	13,700	14,900
Chlorococcum		285		
Actinastrum	857	3,700		
Coelastrum	1,400	1,400		
Ooeystis			857	
Tetrahedron	285			
<u>Diatoms</u>				
Nitzschia	11,000	10,000		
<u>Pigmented Flagellates</u>				
Euglena	9,300	9,300	3,700	9,300
Phacus	1,900	3,700	3,700	3,700
Chlamydomonas	3,700	9,300	3,700	
Polytoma				9,300
Panderina		3,700		
<u>Higher Forms</u>				
Paramecium	1,800			3,700
DATE: Jan., 1975	7	16	21	27
<u>Blue-Green</u>				
Oscillatoria	0	0	0	0
<u>Green</u>				
Chlorella	36,300	51,700	38,600	41,000
Scenedesmus	48,600	37,100	29,700	50,600
Coelastrum	4,290	1,400		
Ankistrodesmus			571	

APPENDIX J (continued)

DATE: Jan., 1975 (cont'd) 7 16 21 27

Diatoms

Nitzschia 100

Pigmented
Flagellates

Euglena	3,700	3,700		9,300
Phacus		3,700	9,300	9,300
Chlamydomonas	3,700	3,700	8,000	1,900
Polytoma		9,300	9,300	9,300

Higher Forms

Paramecium 1,800

DATE: Feb., 1975 3 10 17 24

Blue-Green

Oscillatoria 0 0 0 0

Green

Chlorella	50,000	50,000	20,600	22,600
Scenedesmus	54,000	54,300	26,300	0

Pigmented
Flagellates

Euglena	9,300	9,300	9,300	9,300
Phacus	9,300	9,300	3,700	9,300
Chlamydomonas	9,300	3,700	3,700	9,300
Polytoma	9,300			

Debris *

Higher Forms

Paramecium	3,700	3,700		
Rotifers		*	*	

*Present

DATE: March, 1975 5 11 17

Blue-Green

Oscillatoria 0 0 0

Green

Chlorella	52,600	76,000	57,100
Scenedesmus	37,100	60,300	29,100
Actinastrum			30

Diatoms

Nitzschia 1,430 100

Pigmented
Flagellates

Euglena	8,000	9,300	9,300
Phacus	9,300	3,700	3,700
Chlamydomonas	3,700	4,000	270

Debris * *

APPENDIX K. ALGAE GENERA, ROCK FILTER INFLUENT organisms/ml

DATE: June 1974	21	24		
<u>Blue-Green</u>				
Oscillatoria	29,900	26,500		
<u>Green</u>				
Chlorella	134,000	217,000		
Scenedesmus	2,900	7,100		
<u>Diatoms</u>				
Nitzschia	6,900	8,600		
Gomphonema		285		
<u>Flagellates</u>				
Euglena	285			
Debris	*			
DATE: July 1974	1	8	22	29
<u>Blue-Green</u>				
Oscillatoria	3,600	11,600	6,700	23,800
<u>Green</u>				
Chlorella	136,000	66,000	80,300	24,300
Scenedesmus	8,300	3,700	2,300	2,000
Chlorococcum		285	3,700	
Actinastrum		1,800	1,800	
Tetraledron			1,800	
<u>Diatoms</u>				
Nitzschia	2,900	857		
<u>Pigmented Flagellates</u>				
Euglena	13,000	3,700	3,700	
Chlamydomonas	3,700	1,800	3,700	3,700
Chlorogonium	9,300			
Mallomonas	3,700			
<u>Higher Forms</u>				
Paramecium				1,800
Protozoa				1,500
*Present				
DATE: Aug., 1974	5	12	19	26
<u>Blue-Green</u>				
Oscillatoria	22,000	22,000	29,000	38,800
<u>Green</u>				
Chlorella	6,300	63,100	15,500	155,000
Scenedesmus	0	1,100	2,000	579
Chlorococcum				9,300
Actinastrum		285		
Tetraledron		1,800		285
Tetradismus	3,700		2,300	1,700
<u>Diatoms</u>				
Nitzschia		1,100	9,700	
Asterionella			3,400	
<u>Pigmented Flagellates</u>				
Euglena	3,700	1,800	1,800	9,300
Chlamydomonas	3,700	2,400	1,800	9,300
Debris		*		
*Present				

APPENDIX K (continued)

DATE: Sept., 1974	3	10	17	24
<u>Blue-Green</u>				
Anacystis		16,000		17,300
<u>Green</u>				
Chlorella		26,300		34,900
Scenedesmus		857		2,000
Actinastrum				3,700
Tetraedron		3,700		
Tetrademus		3,700		
<u>Diatoms</u>				
Nitzchia		3,100		
Asterionella				857
<u>Pigmented Flagellates</u>				
Euglena		1,800		3,700
Chlamydomonas		1,800		
<u>Higher Forms</u>				
Paramecium				1,800

DATE: Oct., 1974	1	8	15	22	29
<u>Blue-Green</u>					
Oscillatoria	33,800	23,500	36,500	35,000	35,000
Anacystis	1,100				
<u>Green</u>					
Chlorella	44,300	23,100	30,000	37,400	18,300
Scenedesmus	3,400	2,000	3,700	2,300	3,400
Actinastrum		571	857	2,000	3,100
Tetraedron	285				
Tetrademus	1,700		1,100		1,100
<u>Diatoms</u>					
Nitzchia		3,100	7,700	6,300	8,900
<u>Pigmented Flagellates</u>					
Euglena	1,800	1,800	3,700		
Phacus		1,800			
Chlamydomonas	1,800	3,700	1,800	1,800	
Debris	*		*		*
<u>Higher Forms</u>					
Rotifera	1,800				
*Present					

DATE: Nov., 1974	12	19	26
<u>Blue-Green</u>			
Oscillatoria	36,700	29,000	22,400
<u>Green</u>			
Chlorella	40,900	62,600	38,300
Scenedesmus	6,000	11,400	11,400
Actinastrum	571	1,100	1,800
Tetrademus	3,400	1,400	
<u>Diatoms</u>			
Nitzchia	9,400	9,142	8,900
Pigmented			

APPENDIX K (continued)

DATE: Nov., 1974 (con't)	12	19	26	
<u>Flagellates</u>				
Euglena		3,700	3,700	
Chlamydomonas	1,800	3,700	9,300	
Debris		*	*	
<u>Higher Forms</u>				
Protozoa		9,300		
DATE: Dec., 1974	3	10	24	31
<u>Blue-Green</u>				
Oscillatoria	22,400	16,200	1,000	173
Anacystis			1,800	
<u>Green</u>				
Chlorella	58,600	56,000	32,900	60,900
Scenedesmus	12,300	20,900	13,700	18,300
Chlorococcum			571	
Actinastrum	857			
Coelastrum	1,400			
<u>Diatoms</u>				
Nitzschia	9,100	6,000	1,800	3,700
Gomphonema	285			
<u>Pigmented Flagellates</u>				
Euglena	9,300	9,300	3,700	3,700
Phacus			1,800	
Chlamydomonas	3,700	9,300	3,700	3,700
Carteria				9,300
Pandorina		3,700		
Debris	*			
<u>Higher Forms</u>				
Paramecium	3,700		3,700	3,700
*Present				
DATE: Jan., 1975	7	16	21	27
<u>Blue-Green</u>				
Oscillatoria	0	0	1,800	0
<u>Green</u>				
Chlorella	25,700	54,000	48,000	43,400
Scenedesmus	27,100	39,700	43,000	50,600
Coelastrum	281	1,800	2,300	
Ankistrodesmus		1,800	2,300	
<u>Diatoms</u>				
Nitzschia			571	1,800
<u>Pigmented Flagellates</u>				
Euglena		1,800	1,800	9,300
Phacus	1,800	3,700dead	9,300	9,300
Chlamydomonas		3,700	1,800	
Polytoma		9,300	9,300	9,300
<u>Higher Forms</u>				
Paramecium	1,800		1,800	

APPENDIX K (continued)

DATE: Feb., 1975	3	10	17	24	
<u>Blue-Green</u>					
Oscillatoria	0	0		0	
<u>Green</u>					
Chlorella	79,400	48,900	19,700	26,600	
Scenedesmus	70,600	62,900	24,000	30,000	
Chlorococcum		*			
<u>Diatoms</u>					
Nitzschia		*			
<u>Pigmented Flagellates</u>					
Euglena	3,700	9,300	3,700	3,700	
Phacus	3,700	3,700	3,700	3,700	
Chlamydomonas	3,700	1,800	3,700	9,300	
Debris		*	*	*	
<u>Higher Forms</u>					
Paramecium	1,800	3,700			
DATE: Mar., 1975	5	11	17	27	29
<u>Blue-Green</u>					
Oscillatoria	0	0	0	3,500	2,900
<u>Green</u>					
Chlorella	25,100	52,600	45,400	60,600	27,700
Scenedesmus	33,000	53,400	32,900	8,900	6,900
<u>Diatoms</u>					
Nitzschia	285	1,100	*	2,900	285
<u>Pigmented Flagellates</u>					
Euglena	9,300	3,700	3,700	9,300	9,300
Phacus	1,800	1,800	3,700	1,800	
Chlamydomonas	500	3,700	3,700		
Debris	*	*			
<u>*Present</u>					

*Present

APPENDIX L. ALGAE GENERA, LARGE ROCK FILTER EFFLUENT

DATE: June, 1974	21	24		
<u>Blue-Green</u>				
Oscillatoria	54,200	4,700		
<u>Green</u>				
Chlorella	120,000	277,000		
Scenedesmus	1,100	285		
Chlorococcum	286			
Coelastrum		571		
<u>Diatoms</u>				
Nitzschia	1,100	1,100		
<u>Pigmented Flagellates</u>				
Euglena	285	11		
Debris	*			
*Present				
DATE: July, 1974	1	8	22	29
<u>Blue-Green</u>				
Oscillatoria	919	11	11	292
<u>Green</u>				
Chlorella	68,600	1,700	7,700	10,000
Scenedesmus	571	2,700	8,000	
Chlorococcum				3,700
Actinastrum	3,700			
<u>Diatoms</u>				
Nitzschia	1,100	0	0	8,000
<u>Pigmented Flagellates</u>				
Euglena	3,700	0	3,700	9,300
Chlorogonium	3,700			
Pandorina				9,300
DATE: Aug., 1974	5	12	19	26
<u>Blue-Green</u>				
Oscillatoria	1	692	4,500	3,630
<u>Green</u>				
Chlorella	14,900	8,900	29,400	25,400
Scenedesmus	7,700		1,000	
Tetradasmus	3,700			
<u>Diatoms</u>				
Nitzschia	0	0	0	900
<u>Pigmented Flagellates</u>				
Euglena	3,700	3,700	0	3,700
Chlamydomonas	1,800			3,700
Pandorina	1,800			
Debris			*	*
*Present				

APPENDIX L (continued)

DATE: Sept. 1974	10	24			
<u>Blue-Green</u>					
Oscillatoria	11,500	6,800			
<u>Green</u>					
Chlorella	12,600	12,600			
Scenedesmus	571	1,400			
Actinastrum	1,850				
Oocystis		3,700			
<u>Diatoms</u>					
Nitzschia	571	1,400			
Gomphonema	1,142				
<u>Pigmented Flagellates</u>					
Euglena	3,700	0			
Debris	*				

DATE: Oct., 1974	1	8	15	22	29
<u>Blue-Green</u>					
Oscillatoria	9,400	13,000	14,800	22,500	25,900
Anacystis	1,850				
<u>Green</u>					
Chlorella	8,900	9,700	8,300	20,300	20,900
Scenedesmus	1,100	7,000	283	1,700	1,700
Actinastrum	1,850	857	1,143		
<u>Diatoms</u>					
Nitzschia	571	7,000	857	5,100	2,600
<u>Pigmented Flagellates</u>					
Chlamydomonas	1,850				
Debris		*	*	*	
*Present					

DATE: Nov., 1974	12	19	26		
<u>Blue-Green</u>					
Oscillatoria	19,800	16,100	12,200		
Anacystis		1,850			
<u>Green</u>					
Chlorella	23,400	25,900	10,000		
Scenedesmus	571	1,700	2,000		
Chlorococcum		1,850			
Tetradesmus	571				
<u>Diatoms</u>					
Nitzschia	2,000	2,900	857		
<u>Pigmented Flagellates</u>					
Euglena	3,700	0	3,700		
Phacus	1,850				
Chlamydomonas			3,700		

DATE: Dec., 1974 3 10 24 31

DATE: Jan., 1975	7	16	21
------------------	---	----	----

DATE: Feb. 1975 3 10 17 24

100

APPENDIX L (continued)

DATE: Feb., 1975(cont'd) 3 10 17 24

Diatoms

Nitzschia 8,000 0 0

Pigmented
Flagellates

Euglena 9,300 3,700 3,700 9,300

Phacus 1,850 3,700 1,850 3,700

Chlamydomonas 3,700 1,850 1,850 1,850

Debris *

*Present

DATE: March, 1975 5 11 17 27 29

Blue-Green

Oscillatoria 0 0 0 1,900 1,800

Green

Chlorella 28,000 24,300 63,400 52,900 40,300

Scenedesmus 22,000 20,600 18,000 7,100 4,600

Diatoms

Nitzschia 7,700 0 857 571

Pigmented
Flagellates

Euglena 7,000 8,000 8,000 3,700 3,700

Phacus 1,850 1,850 1,850 1,850 0

Chlamydomonas 7,000 9,300 3,700 1,850 0

Chlorogonium 9,300

Debris *

*Present

APPENDIX M. ALGAE GENERA, DOWNSTREAM TUBE IN LARGE ROCK FILTER

DATE: Sept., 1974	10	24			
<u>Blue-Green</u>					
Oscillatoria	11,900	7,200`			
<u>Green</u>					
Chlorella	12,600	5,400			
Scenedesmus	3,700	3,700			
Oocystis	571				
Actinastrum		3,700			
<u>Diatoms</u>					
Nitzschia	571	3,700			
Gomphonema	1,400				
<u>Pigmented Flagellates</u>					
Euglena	1,800				
Phacus	1,800				
<u>Debris</u> *					
<u>Higher Forms</u>					
Rotifera		3,700			
*Present					

DATE: Oct, 1974	1	8	15	22	29
<u>Blue-Green</u>					
Oscillatoria	11,100	12,900	17,000	22,300	32,500
Anacystis					Clumps
<u>Green</u>					
Chlorella	9,400	2,900	11,400	10,300	18,000
Scenedesmus	3,700	0	285	857	2,300
Actinastrum				285	2,600
Tetradesmus			285		
<u>Diatoms</u>					
Nitzschia	1,800	-	1,700	1,100	
<u>Pigmented Flagellates</u>					
Chlamydomonas		1,800	1,800		
<u>Debris</u> * *					
<u>Higher Forms</u>					
Nemotoda	1,800				
*Present					

DATE: Nov., 1974	12	19	26		
<u>Blue-Green</u>					
Oscillatoria	24,000	28,500	21,600		
<u>Green</u>					
Chlorella	18,600	42,600	18,600		
Scenedesmus	857	7,400	2,300		
Actinastrum	285	2,000	857		
<u>Diatoms</u>					
Nitzschia	3,400	7,700	9,100		

APPENDIX M (continued)

DATE: Dec., 1974	3	10	24	31
<u>Blue-Green</u>				
Oscillatoria	13,800	4,000	200	184
<u>Green</u>				
Chlorella	49,100	34,000	15,700	30,600
Scenedesmus	14,600	7,400	4,000	11,700
Actinastrum	857	285		
Oocystis			857	
Coelastrum	571			
Tetradismus	285			
<u>Diatoms</u>				
Nitzschia	9,100	6,900	900	
<u>Pigmented Flagellates</u>				
Euglena			1,800	
Phacus		1,800	1,800	3,700
Chlamydomonas				3,700
<u>Higher Forms</u>				
Paramecium			3,700	
DATE: Jan., 1975	7	16	21	27
<u>Blue-Green</u>				
	0	0	0	0
<u>Green</u>				
Chlorella	22,000	56,300	15,700	28,900
Scenedesmus	18,200	38,600	13,700	33,000
Chlorococcum				1,800
Coelastrum	2,600	3,100	285	
Ankistrodesmus		3,100	285	
<u>Diatoms</u>				
Nitzschia			1,800	
<u>Pigmented Flagellates</u>				
Euglena				3,700
Phacus			3,700	3,700
Chlamydomonas	3,700	3,700		3,700
Chlorogonium		9,300	3,700	
Polytoma		3,700	9,300	
<u>Higher Forms</u>				
Paramecium			9,300	
Rotifera				*
*Present				

APPENDIX M (continued)

DATE: Feb. 1975	3	10	17	24
<u>Blue-Green</u>				
Oscillatoria		200		
<u>Green</u>				
Chlorella	47,700	47,100	13,700	26,300
Scenedesmus	42,600	76,000	16,000	29,400
<u>Diatoms</u>				
Nitzschia	500			
<u>Pigmented Flagellates</u>				
Euglena	9,300	3,700	3,700	9,300
Phacus	1,800	3,700	3,700	3,700
Chlamydomonas	3,700	1,800	3,700	1,800
Carteria	1,800			
<u>Debris</u>		*		*
<u>Higher Forms</u>				
Paramecium		1,800		
		Cyclops stirring		
*Present				

DATE: March 1975	5	11	17	27	29
<u>Blue-Green</u>					
Oscillatoria		Rare	Rare	2,400	2,700
<u>Green</u>					
Chlorella	22,900	29,700	44,300	36,000	34,900
Scenedesmus	38,600	40,000	32,900	11,400	54,000
<u>Diatoms</u>					
Nitzschia			Seen	857	2,300
<u>Pigmented Flagellates</u>					
Euglena	9,300	3,700	3,700	9,300	3,700
Phacus	9,300	1,800	900		
Chlamydomonas	1,800	3,700	9,300		
<u>Debris</u>	*	*			
*Present					

APPENDIX N. ALGAE GENERA, SMALL ROCK FILTER EFFLUENT

<u>DATE: June 1974</u>	<u>21</u>	<u>24</u>		
<u>Blue-Green</u>				
Oscillatoria	8,756	3,600		
<u>Green</u>				
Chlorella	188,000	227,000		
Scenedesmus	300	300		
<u>Diatoms</u>				
Nitzschia	2,600			
<u>Debris</u>	*			
<u>DATE: July 1974</u>	<u>1</u>	<u>8</u>	<u>22</u>	<u>29</u>
<u>Blue-Green</u>				
Oscillatoria	541	0	541	184
Anacystis			1,800	
<u>Green</u>				
Chlorella	24,000	6,900	52,900	15,100
Scenedesmus	300	300	11,700	0
<u>Diatoms</u>				
Nitzschia		271	1,800	
<u>Pigmented Flagellates</u>				
Euglena				3,700
Chlamydomonas	4,000	9,300	1,800	3,700
Chlorogonium	4,000			
<u>DATE: Aug., 1974</u>	<u>5</u>	<u>12</u>	<u>19</u>	<u>26</u>
<u>Blue-Green</u>				
Oscillatoria	64	11	508	324
<u>Green</u>				
Chlorella	4,600	10,600	20,900	15,700
Scenedesmus	36,600	44,600	143,700	128,000
<u>Diatoms</u>				
Nitzschia				1,500
<u>Pigmented Flagellates</u>				
Euglena		3,700		1,800
Chlamydomonas	3,700			3,700
<u>Higher Forms</u>				
Nemotoda	*		*	
*Present				

APPENDIX N (continued)

DATE: Sept, 1974	10	24			
<u>Blue-Green</u>					
Oscillatoria	11,600	4,900			
<u>Green</u>					
Chlorella	14,300	8,900			
Scenedesmus	1,400	571			
<u>Diatoms</u>					
Nitzschia	271	857			
<u>Pigmented Flagellates</u>					
Euglena	1,800	1,800			
Phacus	1,800				
<u>Debris</u>					
	*	*			
<u>Higher Forms</u>					
Paramecium		1,800			
*Present					
DATE: Oct., 1974	1	8	15	22	29
<u>Blue-Green</u>					
Oscillatoria	7,000	5,300	4,300	12,500	13,000
Anacystis	271	271	*	571	271
<u>Green</u>					
Chlorella	1,100	6,300	Rare	10,600	6,300
Scenedesmus	857	300		857	571
<u>Diatoms</u>					
Nitzschia		857	*	2,700	1,400
<u>Pigmented Flagellates</u>					
Euglena			*		
<u>Debris</u>					
		*			
<u>Higher Forms</u>					
Protozoa			*		
*Present					
DATE: Nov. 1974	12	19	26		
<u>Blue-Green</u>					
Oscillatoria	15,500	3,600	76		
<u>Green</u>					
Chlorella	13,400	19,700	10,900		
Scenedesmus	857	857	857		
Actinastrum	271				
Oocystis			571		
<u>Diatoms</u>					
Nitzschia	2,000	1,700	571		
<u>Pigmented Flagellates</u>					
Euglena		3,700	3,700		
Chlamydomonas		3,700	3,700		

APPENDIX N (continued)

DATE: Dec., 1974		
	3	10
<u>Blue-Green</u>		
Oscillatoria	0	0
Anacystis		1,800
<u>Green</u>		
Chlorella	16,900	0
Scenedesmus	2,900	3,700
Coelastrum	571	571
Oocystis	857	
<u>Diatoms</u>		
Nitzschia	2,300	*
<u>Pigmented Flagellates</u>		
Phacus		1,800
Chlamydomonas	9,300	9,300
<u>Higher Forms</u>		
Paramecium		3,900
*Present		

APPENDIX O. ALGAE GENERA, DOWNSTREAM TUBE IN SMALL ROCK FILTER

DATE: Sept. 1974	10	24			
<u>Blue-Green</u>					
Oscillatoria	8,800	9,300			
<u>Green</u>					
Chlorella	12,300	11,700			
Scenedesmus		1,400			
Actinastrum		3,700			
<u>Diatoms</u>					
Nitzschia		1,100			
Gomphonema	3,700				
<u>Pigmented Flagellates</u>					
Euglena	1,800				
Phacus	1,800				
Chlamydomonas	1,800				
<u>Debris</u>	*	*			

DATE: Oct., 1974	1	8	15	22	29
<u>Blue-Green</u>					
Oscillatoria	12,000	8,000	5,900	8,000	19,000
<u>Green</u>					
Chlorella	9,700	2,300	6,000	Rare	10,300
Scenedesmus	571	1,800	285	Normal flora	1,700
Actinastrum	3,700		285		1,700
<u>Diatoms</u>					
Nitzschia	857		571		3,700
<u>Pigmented Flagellates</u>					
Euglena	1,800				
<u>Debris</u>			*		
<u>Higher Forms</u>					
Paramecium	3,700		1,800	Seen	
Protozoa		1,800			
*Present					

DATE: Nov., 1974	12	19	26		
<u>Blue-Green</u>					
Oscillatoria	2,300	500	Rare		
Anacystis		1,800	All normal flora present but rare.		

DATE: Dec., 1974	3	10			
------------------	---	----	--	--	--

Cloudy.
No identifiable organisms.